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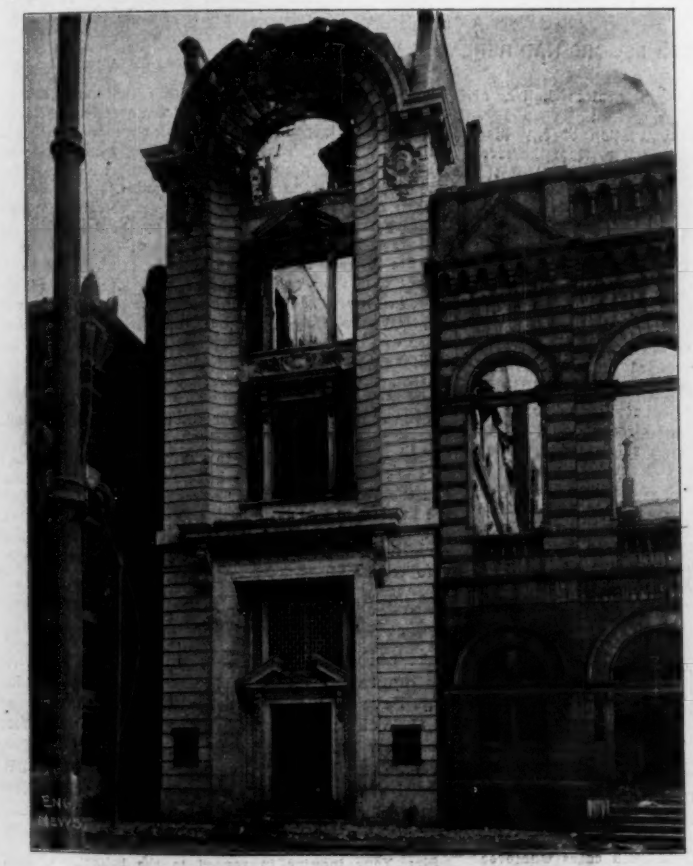
DETAIL STUDIES OF FIREPROOF BUILDINGS IN THE BALTIMORE CONFLAGRATION.

In the general account of the Balitmore fire published in our last issue many of the minor details of damage were omitted until decisive evidence of their character could be presented. Even now the full story of the fire cannot be told, for the facts must be collected from many witnesses and from a detail study of the ruins by experts with no end to serve but that of truth. Some time must elapse before these facts are collected and comparison can be made between them.

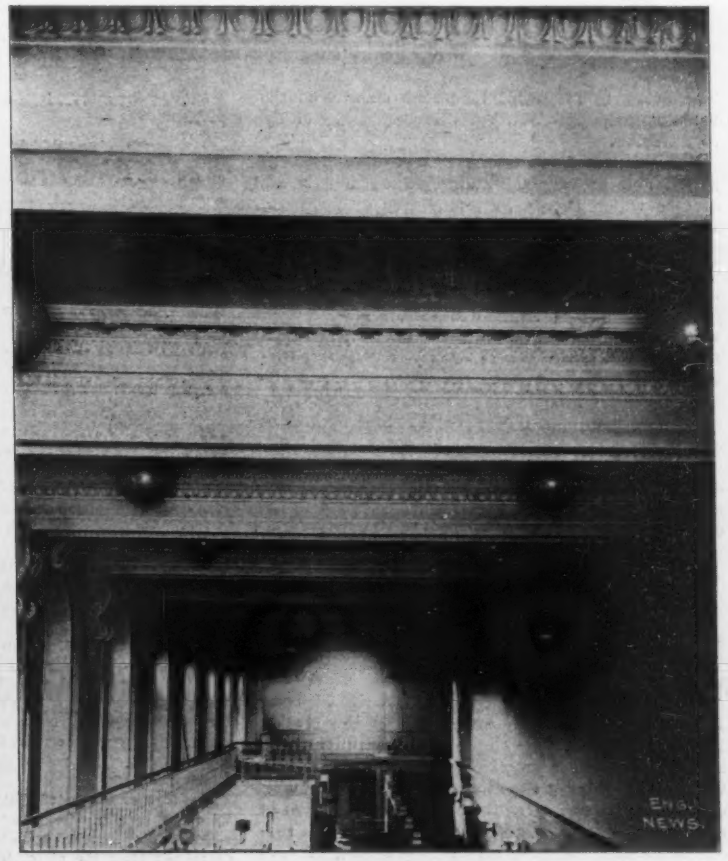
In the week which has elapsed since our first account, however, many new facts have been ascertained and some of them make it necessary to modify a few of the statements made originally. In addition, we have requested a number of engineers, who have visited and examined the ruins, to state briefly the results of their investigations and such of the replies to this request as have been received up to the time of publication are given farther on in this article.

WATER SUPPLY.—At no time during the fire was there any scarcity of water for fire-fighting purposes. This statement is important to remember since the early newspaper reports of the fire laid much of the blame for the rapid spread of the conflagration upon the lack of water. The facts as obtained from the engineers of the Baltimore Water Department are as follows: The water supply of Baltimore is divided into a high service, a middle service and a low service system. The fire originated in the district supplied by the middle service system which takes its water from reservoirs. A couple of hours after the start of the fire these reservoirs were supplemented by the pumps of the Mount Royal station, which have a capacity of 17,500,000 gallons a day. As soon as the fire reached the low service district the middle service supply was added to it by means of the connecting by-pass and in this low level section the pressure was maintained at 80 lbs. The amount of water taken from the various reservoirs in addition to that pumped directly is estimated to be about as follows: Druid Lake reservoir, about 6,000,000 gallons; Clifton reservoir, 20,000,000 gallons; and Montebello reservoir, 34,000,000 gallons.

ELECTRIC WIRES AND GAS MAINS.—It is interesting to note that in the burned district all



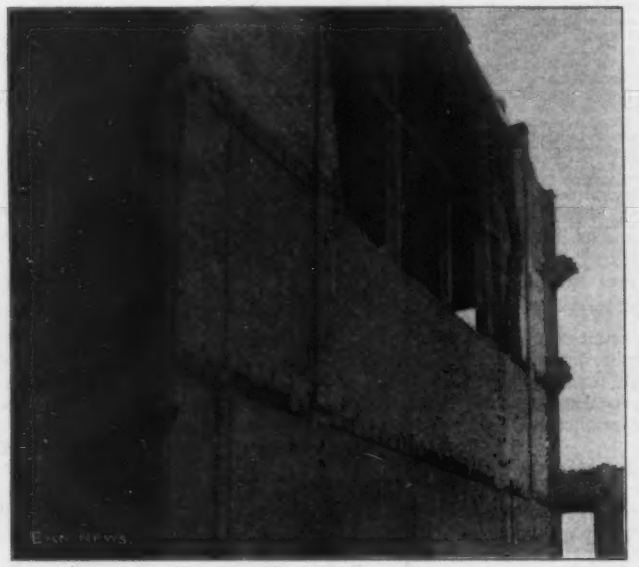
View of Exterior.



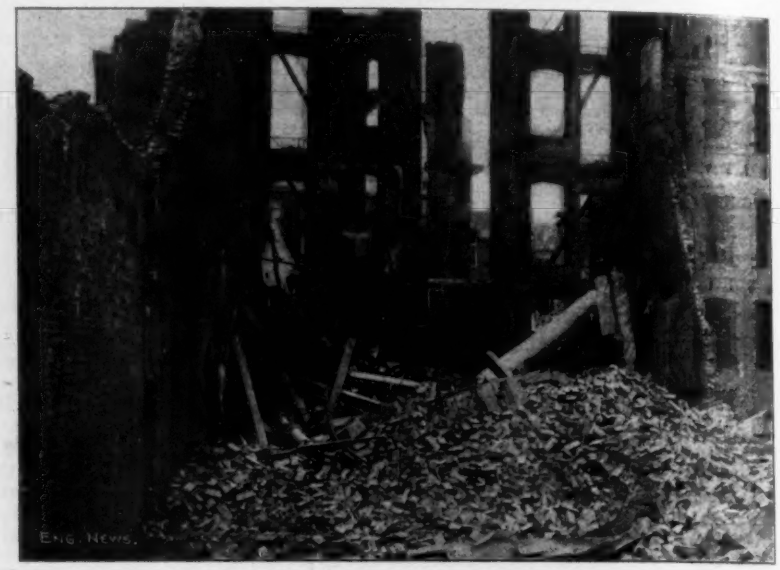
Upper Part of Banking Room on Ground Floor.

THE COMMERCIAL AND FARMERS' NATIONAL BANK BUILDING, BALTIMORE, MD.

the telegraph and telephone wires, railway feeders and electric light mains were in subways. These wires in subway were entirely unharmed. The trolley wires and the distribution branches of the electric lighting wires were carried on poles and they were entirely destroyed. The gas mains were of course broken at nearly every building and the leaking gas burned and caused frequent small explosions until it could be turned off. Owing to the wires being underground it was possible to make repairs and restore telegraph communication before the fire was under control, although both the Western Union and Postal Telegraph main offices were completely burned out.



Floors Still in Place.



A Complete Wreck.

TWO BUILDINGS IN WHICH REINFORCED-CONCRETE FLOORS HAD REPLACED WOODEN FLOORS.

The delay in restoring telephone communication was somewhat greater, but was only a day or two in duration.

PROPOSED IMPROVEMENTS.—The opportunity for improving its municipal conditions and service which is offered to the city of Baltimore in rebuilding its burned district was commented on in our last issue. The time is too early of course for formulating a definite programme, but it is gratifying to note that steps to this end have been taken by the city officials and that the action is supported by many of the wealthy and progressive citizens. In general, it can be stated that conferences between the city and state officials have resulted in an understanding that the state will grant authority to the city to borrow a sum sufficient to rembdel and restore the burnt district according to the most recent and perfect standards in street lay-out and building construction. With this money it is proposed to resurvey and widen the streets and to improve their grades. In addition a complete sewerage system is to be constructed. Another important improvement is to adopt a new building ordinance, which will be in all its requirements equal to the very best now in force in the country. One of the requirements which is being most strongly urged is that the height of buildings shall be limited.

Co-operating with the city officials the Citizens' Emergency Committee, appointed by the Mayor, has submitted through its subcommittee on streets and its subcommittee on buildings suggestions for improving the street lay-out in the burnt district, and also for regulating the construction of new buildings. The subcommittee on streets recommends the widening and straightening of several of the main streets and also that a section comprising about two blocks and a section comprising one block at different points be set aside as plazas or parks. This report is only partial and will be followed by a supplemental report. The reort of the subcommittee on buildings is in full as follows:

The subcommittee on the height of buildings and building laws reports that it advises, in order to meet the emergency of present conditions, that permits be granted to build in what is known as the burnt district, where there is to be no change of the streets, with the following modification of the existing building laws:

First. Under the existing building law non-fireproof buildings are permitted to be built to the height of 100 ft. This, in the opinion of your committee, should be changed, and such buildings should not exceed 85 ft. in height, and no building should hereafter be erected more than 175 ft. high. This modification of the law to cover the entire city.

Second. That permits for the reconstruction of the present fireproof structures so-called in the burnt district be issued, provided such reconstruction be in accordance with the latest practice in fireproof construction.

Third. That face bricks of all walls shall be bonded to the walls with bricks and not with metal ties.

Fourth. That lookouts for all metal cornices shall be of metal.

Fifth. That no projection or obstruction of any kind shall be allowed beyond the building line, from the level of the sidewalk to a point 10 ft. above the level of the same.

Your committee suggests that the necessary legislation be obtained to prevent the constant encroachment upon the sidewalks. It has become the practice for owners of property bounding upon the streets to obtain by ordinance or otherwise so-called rights in the public highway, by which they appropriate to themselves, contrary to the purposes for which a street is dedicated, the use of a large portion of the sidewalk, to the great injury of the public; in many instances the board of estimates has granted these so-called rights for a consideration.

Your committee are unanimously of the opinion that such sales of public interest in the streets should not be permitted. The compensation, as a rule, is grossly inadequate, and, in fact, such interference with a public right should not be permitted at any price. These encroachments upon the building line make a series of irregularities, aside from the interference with public use, which are very unsightly. The committee understands that in order to preserve the building line against such encroachments it will be necessary to amend the charter. They suggest that the charter be so amended without delay.

They further suggest that this provision be made applicable to all unimproved blocks in the city of Baltimore. It is to be regretted that it is deemed impracticable to make this law applicable where buildings are now standing, and where they have built upon the theory that the individual property owner has a right to appropriate a large portion of the public sidewalk for ingress and egress to his property.

It is further suggested that this law should be applicable to every case in the burnt district where the building which now encroaches upon the street has to be torn down or rebuilt from the street level. In such cases whatever compensation had been paid to the city for the license to build beyond the building line should be returned.

Sixth. Your committee reports that owing to the very short time which they have to consider the questions submitted to them they find it impracticable to prepare any elaborate system of building laws. Such laws which unquestionably affect the welfare of the city and are to a certain degree a limitation upon the rights of property holders, should only be passed after full and careful consideration. No set of laws can be passed which will not, in some cases, work hardships; but every effort should be made in the preparation of building laws that, while the public is protected, private rights should be respected.

Your committee is fully satisfied that the existing building laws of Baltimore city could, with great advantage to the public, be revised both as to the terms of the law and the methods of enforcement. With this view your committee respectfully suggests the appointment by the mayor of a commission to accomplish this purpose. The commission should consist of at least one lawyer, two architects, one builder, one sanitary engineer, one representative of the board of underwriters, one structural engineer, one practical man of affairs, the city engineer and the inspector of buildings, the mayor to be ex officio a member.

While it would be extremely advisable that this building code should be adopted before extensive building operations should be commenced within the burnt district, your committee is fully sensible of the necessity of placing the building inspector in the position to at once issue building permits. They have, therefore, merely made the slight modification suggested in this report as a condition upon which permits should be granted.

Your committee is satisfied that the so-called fireproof buildings which have been injured by the fire will be repaired, and advantage will be taken of the experience of the fire to make them less liable to be injured to the same extent that they were injured by the late conflagration; that, in view of the intense heat of the recent fire, it was impossible to protect any building against injury unless there was an absolutely blank wall interposed between the building and the fire, and that all other kinds of protection, such as fire shutters, would have yielded to the heat.

Your committee is of the opinion, in view of this fact, that the condition of the so-called fireproof buildings is a strong recommendation to the architects and builders who planned and constructed the same. They believe that had the fire originated near any one of the said buildings the buildings could have been and would have been saved, but, as already stated, anything in the path of such a fire, when fully under way, was bound to be to a certain degree consumed.

Opinions of Experts.

At our request opinions on the effects of the Baltimore fire on structural materials and buildings have been prepared by the following persons: S. C. Weiskopf, Chief Engineer, Thomson-Starrett Co., New York city; H. de B. Parsons, M. Am. Soc. C. E., Consulting Engineer, New York city; Carl F. Greishaber, Engineer, Carrere & Hastings, New York city; and Paul Starrett, Vice-President. George A. Fuller Co., New York city.

Sir: Your inquiry in regard to the behavior of steel fireproof buildings in Baltimore during the recent fire is at hand. We are having a detailed report made on these by our engineers, which we expect will be ready shortly, and will be glad to furnish you with a copy of same. We would say in a general way, however, that our fireproof work met all our expectations fully. The steel structures are practically intact, and the fireproofing protected it perfectly excepting in a few instances, where slight damage has been done. The fronts will have to be patched up and repaired where the stone and terra cotta ornamental work has been disfigured, but aside from this the only thing that will have to be replaced will be the

woodwork and such other interior work as would very naturally be damaged. Yours truly, Paul Starrett.

New York City, Feb. 18, 1904

Sir: I am in receipt of your letter, in which you request an expression from me as to the conclusions arrived at in the examination of steel framed fireproof buildings at Baltimore, after the recent fire.

In answer thereto, I would state that I have spent but one day in Baltimore since the fire, and could only make a casual examination. The military restrictions and the generally dangerous conditions prevailing so early after the fire were such that no thorough investigation could be made; so that whatever statements I may make to you at this time are not the result of an exhaustive examination, but more in the nature of conclusions derived from a casual inspection. I expect, in the near future, to be called upon to make an exhaustive examination of one or more of the steel structures, and after the conclusion of my work in that direction, I shall be pleased to give you such reports as I can consistently permit you to publish.

Speaking in a general way, therefore, I would say that nearly all—if not all—of the steel framed buildings, constructed in accordance with our present methods, withstood the conflagration admirably, and I am of the belief that the frame work of all of them can be saved, comparatively little expense being necessary to put them in proper condition.

Unfortunately, the buildings have not been subjected to the severe test that it is generally supposed they have undergone, for it is quite evident that little or no water was thrown on them during the extreme heat of the flames. I regard the severest test a building of this character can be put to, is to have it attacked by a heavy stream of water during such times when the material is very hot, and I saw no evidence of the fact that a great deal of water was thrown during the conflagration.

However this may be, we do know that the steel-framed buildings are standing apparently in proper condition, so far as the frame is concerned, and all of the buildings of other character are completely destroyed, and, if from no other standpoint, we can conclude that buildings of the steel framed type will at least hold their positions, saving most of the vaults and valuables therein contained, and permitting the rebuilding of the "trimmings" at a comparatively small expense and in a short length of time, affecting a saving in the reconstruction heat was evidently very intense locally, and, in one case (I think, the Calvert Building) one of the columns on the 9th floor buckled badly, but the three stories above did not collapse.

In reference to the floor construction—the buildings in which the hollow tile arch was used, the floors in nearly all cases remained intact; here and there some of the blocks were broken, but the damage thus caused is trivial and the repairs can be made at a very slight expense. In the entrance of the Continental Trust Company's Building, the bottom slabs of all the hollow tile blocks are gone, and it is the general impression that this was caused by the fire. However, this is not the case, for I learned while in Baltimore, that during the construction of the building, it was found that the marble ceiling was too low, and, very unwisely, the bottom slabs of all the hollow tile arches were removed, to obtain a few inches more of head room. Even this floor withstood the ordeal perfectly and is intact, although most of the marble ceiling dropped and the rest has since been removed.

I understand that the concrete floors also withstood the terrible strain very well, but did not personally make an examination of any of them. There is one small four-story building, built entirely of one of the concrete systems (I think, the Hennebique), but, while this building is still standing, it is extremely doubtful whether any of its construction could be used in the rebuilding of it, as it is very evident that some of the concrete girders are cracked, and I know of no way of making repairs to such a form of construction.

Trusting that such information as the above is what you are desirous of having at this early stage, and again assuring you that later on I will give you the results of a more minute investigation, if I can consistently do so, I remain,

Very truly yours, S. C. Weiskopf.

New York City, Feb. 19, 1904.

Sir: The conflagration which swept over some 150 acres of the business portion of the City of Baltimore, between Feb. 7 and 9, will be fruitful in forcibly illustrating the effect of fire along lines which have been well known for some time past. Being interested as a student in the question of modern fire-resistant construction to withstand the attack of heat, I visited Baltimore last week for the purpose of studying the problem on the ground.

After having become accustomed to the immense area devastated and to the fearful sweep of the flames, the first impression was that of the man who said "I told you so;" and the second, was the almost total destruction of combustible material in the ruins; that is, the lack of fine ash, cinder and partially burned material. The fire certainly performed its work in a clean and decided manner.

The impression of "I told you so," was the result of the external hazard, which existed in the burned district of Baltimore to a large extent.

Those viewing the ruins after the fire was extinguished, should be careful before enunciating opinions, to differentiate the damage caused by the fire itself from that caused by the dynamite used both during the fire and afterward in order to raze walls and buildings which were considered dangerous. All the buildings or walls which had to be blown down by dynamite, however, were so injured by the fire as to be classed as "destroyed," that is, so injured as to be beyond repair.

The dynamite used during the period of the fire, with the object of creating a "fire-stop," did not appear to be as successful as it was hoped. The cause was due to the high wind which was prevailing, estimated, as I was informed by observers at the time of the fire, as high as 30 to 40 miles an hour. Also, the heat was so intense that the fire jumped the space cleared by dynamite as easily as it did the narrow streets.

Along the outskirts of the fire there are the usual number of old and inflammable structures, which withstood the attack in a manner rather remarkable. The building of Gittings & Co. is one of these examples. This building was of brick, with ordinary wood construction, but was built some years ago and presumably in a solid manner. The buildings on two sides were destroyed, and the buildings on the opposite side of the street were likewise consumed. The Gittings offices, however, were occupied for business purposes as soon a the adjacent ruins were sufficiently cool. It is probable that this building received considerable outside aid in order to protect a Government building opposite.

In the same way the U. S. Appraiser's Store No. 1, on Gay and Lombard Sts.—in the heart of the burned district—although constructed over 65 years ago, was enabled to offer effective resistance. This building was constructed with very thick brick walls, with small windows protected by inside shutters on the upper stories. The floors were of brick arch construction. The monolithic character of the building, with its protection against external hazard, were the causes which enabled it to offer effective resistance. It probably would have protected its contents had not the fire entered through the roof, which was left vulnerable. Although the heat of the burning contents must have been great, the cost of repairing this building will probably be small.

The large proportion of the buildings were of the non-fireproof construction class. These buildings were totally destroyed with their contents, and only those brick walls left standing which were of sufficient thickness to act as self-supporting fire walls. The destruction of these buildings is the more marked when they are compared

Columns with Pipes Beneath Fireproofing.

An Overheated and Buckled Column.
This is the only column found which buckled in this way.

EXAMPLES OF BARE COLUMNS IN THE CALVERT BUILDING.

of the buildings, which, in itself, would be sufficient to warrant the adoption of this type.

I am speaking now, of course, of steel frame structures, in which the steel was properly protected against the fire, as there are numerous examples in which the unprotected steel frames, the beams, trusses, girders, etc., did collapse and were utterly ruined. I have seen many photographs taken after the fire, all of which show the large steel frame buildings perfectly intact, and I have also seen photographs of parts of the buildings, where the

with the wooden telegraph and telephone poles, many of which were still standing throughout the burned district. These poles clearly show the value of the so-called "slow-burning" mill construction.

Buildings of good modern construction, with efforts at fireproofing, are more vulnerable from fire without than from fire within. This was clearly illustrated in Baltimore. Eye-witnesses informed me that the large fireproof buildings were attacked so quickly, that within 15 to 20 minutes after the fire was noticed to have a foothold each

structure appeared to be in flames. This rapidity of spread was due to the unprotected transom lights in the partitions. The lesson to be drawn is, that no building, no matter how fireproof its construction may be, can be expected to protect its contents, unless the window openings are covered to prevent the entrance of the flames through them. Ordinary window glass breaks with the heat of a fire across the street; and when the fire once enters upon any floor, the opened windows on the floors below and above turn the building into a chimney, the flues of which are the stair and elevator wells.

The term "fireproof" has become generic and is used in a broad sense to classify a certain style of modern construction, and a far better name would be "fire-resistant." It is impossible to conceive of a building designed for office and similar purposes that could not be damaged by fire, provided its contents are inflammable. Such modern buildings will resist internal fires and confine them to the places where they originated with wonderful ability. The same buildings when subjected to a fire on many floors at the same time lose their power of protection. In Baltimore the Equitable Building, the Calvert Building, the Baltimore & Ohio Central Building and the Continental Trust Co. Building are all examples.

In all the modern fireproof buildings, the metal construction appears to have stood the heat with an ability varying with the amount of protection which was given to it. In some of the buildings the fire was sufficiently hot to completely destroy the combustible contents, while, as far as the writer could judge, the steel frame work was intact except in isolated members. Where the steel columns were unprotected, they buckled under their loads in a manner exactly resembling the failure of similar columns, as produced at the tests of the Joint Fire Prevention Committee. (See Trans. Am. Soc. M. E., Vol. XVIII., 1897.)

The hollow tile construction of flooring appears to have stood in some buildings better than in others, but in every instance seen by the writer there was failure on the under side from the spalling of the soffits of the floor arches, leaving the steel floor beams in an exposed position. In some buildings the arches had completely failed, due perhaps to falling weights from above, and in such places the floor beams were frequently left standing, although warped by the heat.

The concrete construction in the National Bank of Commerce, the Commercial and Farmers' National Bank, and in Alexander Brown & Co.'s building appears to have given excellent results. The monolithic construction of the concrete is probably responsible for this fortunate outcome. The building of Alexander Brown & Co. was so little damaged that it could have been occupied the next day, as even the papers on the desks were uninjured. Possibly this building was saved by the lowness of its construction and by being surrounded by taller buildings, which assisted in carrying the heat above it. Nevertheless, as viewed by the writer during the short period of his investigation, the lesson as taught by this fire strongly favors the monolithic method of construction. This fact is further exemplified by those tile roofs which still stood intact where protected by a hanging ceiling of expanded metal, although the tile floors in the same building were damaged.

In every instance as noted by the writer the cast-iron columns were unbroken. Some were noticed bent, but a cast-iron column broken while under the action of the fire was not found, although there may have been instances to the contrary.

The spalling of granite and marble facades and trim was noticeable, and the cost of repairing such parts injured will considerably exceed the actual cost of the damaged parts, because their renewal will cause the removal of a considerable portion of apparently undamaged stone work.

The lessons, therefore, which this fire teaches, are that a modern steel building can be built which will protect its structural self but which will not protect its contents if those contents are of an inflammable nature, unless the whole structure is protected from the external hazard. This is a condition which, of course, is difficult to meet, although easy to write on paper.

That good, modern, fire-resistant construction will act as a fire-stop, although a building so constructed, if unprotected from external risks, may become "gutted" and burn out its tenants. In Baltimore, the Equitable, Calvert, Baltimore & Ohio Central, and the Post Office are examples. However, the fire was carried around them on three sides by the more combustible buildings with which they were surrounded.

That large, unprotected, glass windows set in wooden sashes are most vulnerable, even from fires at some distance.

That the more "fireproof" a building is made, the less will be its utility for modern demands. The problem of fireproofing is economic and must be settled by balancing the values involved.

H. de B. Parsons.

22 William St., New York City, Feb. 20, 1904.

A VIEW IN THE NATIONAL BANK OF COMMERC E. ROEBLING CONCRETE FLOORS.

Sir: A walk through the burned district of Baltimore, immediately after the fire and before the streets were cleaned up, was deeply impressive. A whole volume of valuable lessons could be gleaned at a single reading.

Of course the most interesting reading to the architect and engineer was the behavior of "fireproof" and skeleton-framed buildings. These were interesting and changed many established and accepted theories, but items worthy of note were found throughout the entire burned area.

I was fortunate enough to cover the field several times, with professional friends, and have had the advantage of their eyes as well as my own.

The Equitable Building, although on the edge of the burned district, suffered as much if not more than the others. The fire came through the Calvert into the Equitable and completely gutted it. Everything inflammable was consumed.

The walls of this building are self-supporting heavy brick walls, with granite ashlar for the first three stories, and brick and terra cotta facing for the other seven. The beams are all of steel and rest, including at walls, on square cast-iron columns. At walls the cast-iron columns are enclosed in the brick work. The floor construction was, I am told, originally intended to be of Guastavino tile, but was executed in 6-in. deep terra cotta blocks, of end to end construction, and laid in segmental arch with a rise of about 6 ins. Spans seem to be from 7 ft. to 9 ft. The tops of arches were not filled with concrete nor were there any sleepers. The under floor was of 2-in. plank, laid directly on beams, and finished floor was nailed to that. Partitions and column protection were of material known locally at "limotile," and beams were unprotected save for the plastering.

The walls are in excellent shape, better than any of the more modern buildings that were subjected to the same test. Beams are in bad shape, the fire having heated a considerable number of them so that they have sagged perceptibly. This shows the evil of unprotected flanges, and value of efficient beam protection. The covering of interior columns, as well as the partitions, failed. The limotile wherever used in this building is practically all gone. The condition of columns, with the exception of three on eighth story, is very good, and apparently they will not have to be renewed. Of the three on eighth story that have failed, two are bent noticeably, and one is bent so as to make a rupture. Had this been on one of the lower stories, in my opinion it would have let down the stories above. The tile arches are weakened and all will probably have to be taken out. The intense fire caused by the burning of the 3 ins. of floor, the absence of concrete filling over the arches, and the heating of the unprotected beams, both upper and lower flanges being unprotected, probably caused this weakening. That they were badly weakened is evidenced by the lowering of safes falling through, and some of the floors falling because of the jarring caused by dynamiting.

The main stairway is a good exhibit of the property of cast iron in a fire and the failure of slate. The entire stairway bay is of cast iron, and with windows, handrail, and nearly all slate gone, the iron seems to be as good as the day it was put in. It must be remembered, however, that there was probably no water used, otherwise the story might be different.

Slate generally acted badly. It shivered into splinters. It should not be used for stairs unless it has a better fire-resisting foundation than itself.

On the interior court the walls were lined with enameled brick. These were bonded into backing with a clip bond. The facing has given away in large surfaces, exposing the backing, thus showing the failure of the clip bond.

On the exterior the Milford granite acted better under fire than any other granite seen, and the brick, a buff front brick, acted splendidly, especially on the south side where the surface was badly pitted because of the heat, yet none gave way entirely.

In the Calvert Building the conditions were different and more up to modern methods. The structure was all skeleton framed with granite ashlar at first story, and terra cotta and brick facings above. The floor arches were of terra cotta, end to end construction, and flat arches. Partitions and all column protection were of terra cotta blocks. The flanges of all beams were protected with 1-in. thickness of terra cotta. From the exterior the flat arches, while some of their soffits are stripped, seem to be in good condition, but a close inspection from the inside does not give so favorable an impression. The greatest damage is done in the top, as is also the case in the other high buildings. There a much greater percentage of soffits are stripped, more of the partitions are down, and more of the column protection is gone. Also the soffits while apparently intact look as if the terra cotta itself is damaged, and this I found to be so. I threw a small piece of terra cotta up at an apparently intact ceiling, and this stripped the soffit over a considerable surface. My opinion is that a considerable part of the terra cotta is so burned as to destroy the strength of it, making it crumbling and brittle, and some of it will have to be replaced.

The floors seem to be safe, even with some of the soffits stripped, as they hold up the safes and seem firm when stamped upon.

Only one column has suffered in this building, one on the eighth floor, which has buckled at about the center of the story so as to slightly let down the floor above. The fire on this story must have been unusually hot, as is evidenced by surroundings. The sleepers and all inflammable material throughout the building are entirely consumed. The furrows in the concrete are the only means of recognizing that there were sleepers.

A note to make is, that though soffits of flat arches were stripped either more or less, the tile protection of flanges of beams, although at this date considered too thin, were generally intact. The failures of such protection were few. This was true in all buildings where flanges were protected in this way.

In the Continental Trust and the Union Trust buildings conditions were similar to that at the Calvert. Both of these buildings suffered much more than the Calvert on the outside. The condition of the exterior of the Calvert was good, probably due to the fact that the kind of brick used stood test well, and the terra cotta was plain and not ornamental. The Union Trust suffered badly on the exterior. The buff sandstone of the lower three stories is badly damaged, so that it surely will have to be replaced. Both the terra cotta and the brick rustication of the upper stories are badly damaged. The interior is in about the same condition as the Calvert. I know of no failure of columns or beams, but the general appearance of the exterior walls would indicate that a careful inspection of the framework is necessary. The long front has the appearance of being bulged at the center.

The conditions at the Continental Trust are practically the same as the Calvert on the interior. As to all of the exterior, and especially on the east side, conditions are as bad as at the Union Trust, but more serious, because the building is higher. It will require a very careful inspection of the framework and the various joints before the skeleton can be pronounced as safe. The building has gone through a fearful ordeal. The brick facing or veneer of the south and east sides are badly stripped over considerable surfaces. These were bonded with metal ties and they have failed. The cast-iron mullions at the windows on the court, east side, are generally very badly bent and some of them are gone entirely.

The buildings I have mentioned embrace nearly all of the high buildings. All of them were subjected to the fierceness of flame that can only be appreciated by looking over the ground. All glass was melted, as were lead weights; wrought iron was twisted and warped out of all

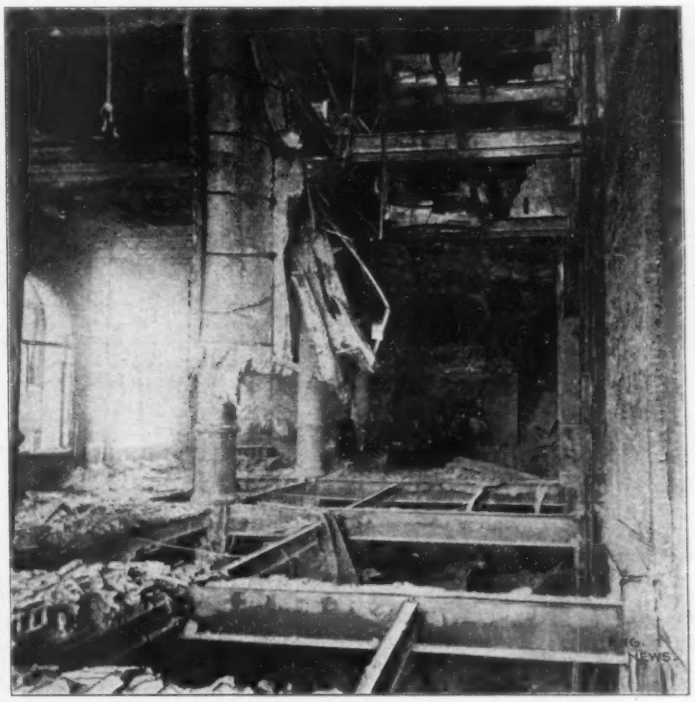
shape; marble was shattered, and in some cases calcined; marble in floors in the Calvert building buckled up and columns in the main hall were destroyed.

The lower buildings appear in some cases to have escaped, because they were low. They certainly did not suffer on the exterior as did their higher neighbors, yet most of these lower buildings, while not damaged greatly on the exterior, were gutted on the inside. The National Union Bank and the Bank of Commerce were two of these, and they were recent structures.

The Safe Deposit & Trust Co., a new building, escaped almost unscathed, and the small building of Brown & Co., bankers, was but slightly damaged.

I can only mention some items of special interest, for the field is so large. At the Commercial & Farmers' Bank Building, a narrow new structure, the first two stories were of steel beams and concrete slabs, and the upper three stories of wood beams. The front was of marble. The upper three stories are entirely gone, and all of the debris, including a safe, has fallen down on the concrete slab floor below. This floor is intact. The front part of building on first story is but slightly damaged, the rear

A TYPICAL VIEW ON THE THIRD FLOOR OF THE CALVERT BUILDING.
(Falling safes wrecked floors in this building. The wire-lath formed a part of the partitions.)



A VIEW IN THE EQUITABLE BUILDING, SHOWING FLOOR AND PARTITION FAILURES.

is gutted, but all of the concrete floors are in excellent condition.

At the Bank of Commerce, the building is entirely burned out; every vestige of anything inflammable is gone. The only evidences of wood doors are the lock sets, a few hinges, and a few screws. At the windows the only evidences of frames or sash are the melted lead of the sash weights and the fused glass. The floors are constructed of iron beams, with cinder concrete slabs, and the haunches of beams are loaded with concrete. Bottom flanges are protected with wire and plastering lath. The plastering was applied directly on the concrete floor slabs, but is now all gone. The floors are as sound as the day they were put in. The beam flanges are still covered.

A small three-story building, with cast-iron front, on East German St., near Calvert, stood the fire test exceedingly well. This building had originally wood beams, but recently had been reconstructed on the interior with reinforced concrete throughout. The floor slabs, girders and columns were all of the reinforced concrete. The side wall on the west, a party wall, was ripped out by the falling of the beams in the building adjoining, and exposed the entire construction. The building was entirely burned out and the concrete frame was absolutely intact, apparently as good as the day installed.

At the Safe Deposit & Trust Co. Building, which is said to have escaped damage, the north side was subjected to great heat, as is evidenced by the condition of the brickwork. The Sun Building was adjoining on this side, and was a low and not fireproof building, which must have made a short, fierce fire. I am told that windows of the Safe Deposit & Trust Co. Building were of wire glass in metal sash and frames, and that there were inside folding iron shutters. At any rate the windows on the north side were protected so as not to admit the fire into the building. Wire glass at several of the buildings failed because of the extreme heat which melted the glass, but on the other hand there are evidences of wire glass being an efficient protection, of the glass cracking badly and the wire holding same together, which is all that is claimed for it. This was the case in a number of skylights.

At the Chesapeake & Potomac Telephone Building, not a very high one, the floor arches were side construction, terra cotta, flat arches, with the beams protected by terra cotta. The building was totally gutted, all plaster was off the ceilings, but the soffits of arches were in perfect condition.

The only reason I can give for the excellent condition of side construction arches in comparison with the partial failure of those of end to end construction in the more modern buildings, is that all of the joints are entirely filled in the former system; in the latter it is harder for workmen to get thoroughly filled joints, and if a workmen is at all inclined to be careless he does not get his work solid.

In the Baltimore & Ohio Building, and several others, limotile flat arches were used. These were made exactly like the side construction terra cotta blocks. Beams were protected by same material. In every case these arches are standing, without any plaster on them, and apparently intact. The question came up as to whether such arches were weakened because made of the same material that had so badly failed in partitions and column-covering at the Equitable. I asked a safe mover who was taking large safes from one of these buildings as to what precautions he took in moving safes over these floors. He said that he was simply rolling the safes on iron plates, so that in this building, at any rate, the floors are sound. The material acted so badly at the Equitable that it is safe to say it will not be popular for use in floors. As in the case of the side construction terra cotta arches, these arches showed all joints well filled.

Stone generally acted badly. Granite, especially the Maryland, spalled and cracked even where heat did not seem to be great. Marble calcined, and in some places seemed to be consumed with the heat. Limestone and buff sandstone acted badly, and the only brownstone that seemed to stand heat fairly well was a dark brown of the appearance of Connecticut or Belleville.

Terra cotta stood test well where plain, and very badly where highly ornamented. This was especially noticeable at the Maryland Trust Building.

Brick, both common and pressed, stood test best. The south side of Equitable is a good example.

The roofs of the tall buildings were generally flat tile and stood well. The roofs of small old buildings were generally tar and gravel, and helped much to spread the flames. Some of the buildings still standing are spattered with the tar, and one can imagine the heat that came from large burning surfaces of pitch.

The wood cornices of the older buildings did much to spread the conflagration. I was told that during the fire one could look down the streets and see the fire jumping from cornice to cornice. Wood cornices are generally prohibited in projected work in large cities, but measures should be taken to do away and replace with metal those that are of wood, and tarred roofs should be either done away with or protected with sufficient gravel or slag so as not to ignite easily.

The modern vaults protected with steel and brick walls were found to be in good shape after the fire and the contents intact, but the ordinary safes, such as we all have, in nearly every case where subjected to the great heat, failed. I talked with a party who had taken a great many safes from the ruins. He said that if safes were built in, even with only a 9-in. wall (one brick) he generally found contents intact or not absolutely destroyed, but the free standing safes in nearly all cases he found contents gone.

The old brick vaults, with the accepted type of double fireproof steel doors and vestibule, were generally in good condition. The contents were generally found to be safe.

One of the best safe exhibits was a spherical safe, of the Corliss type, near the Hurst Building. This was apparently in perfect condition, although the buildings all around were razed to the ground. I was told that the mechanism worked and that interior was in excellent condition.

One of the surprises was the failure of the tin-clad fireproof shutter, such as advocated by the Board of Fire Underwriters. They apparently failed because of the many joints on the surface. In most cases nothing but the empty shells, twisted in all sorts of shapes, remain. I could find no doors or shutters of the Kalamein type.

The principal points taught by the fire, in my opinion, are these.

That buildings should be protected at all openings with metal frames and sash filled with wire glass and with fire-resisting shutters, either outside or inside.

That the value and necessity of efficiently protecting all structural metal with fire-resisting materials is well illustrated.

That modern methods of floor construction did the duty expected of them, but that concrete construction acted best, that side construction terra cotta acted next best, and that end to end terra cotta construction did not stand test as well as the other two methods.

That the terra cotta of arches and partitions was acted upon and deteriorated under fire, while the concrete, I have seen, apparently did not suffer under fire.

That while laws are being enacted, and steadily being improved for all new buildings, some laws should be enacted that will better the condition of such old buildings as are commonly known as "fire traps." The owners of buildings which are built under new laws will then be in a measure protected against fire from their dangerous neighbors if they be required to make changes by the enforcement of such laws. Very truly,

Carl F. Grieshaber.

New York City, Feb. 22, 1904.

TWIN LIFT BRIDGE OPERATED BY GAS ENGINES; NEW DRAW OVER NEWARK BAY, CENTRAL R. R. CO. OF NEW JERSEY.

A drawbridge of unusual design and erected under difficult conditions was briefly described in

a note in our last issue (Feb. 18, 1904). Some views and general drawings of the structure, reproduced herewith, may serve to further explain the conditions of its location and construction.

The draw is near the eastern end of a 2-mile trestle crossing the lower end of Newark Bay, west of the city of Bayonne, N. J. The existing swing bridge, built in 1887, has long been light

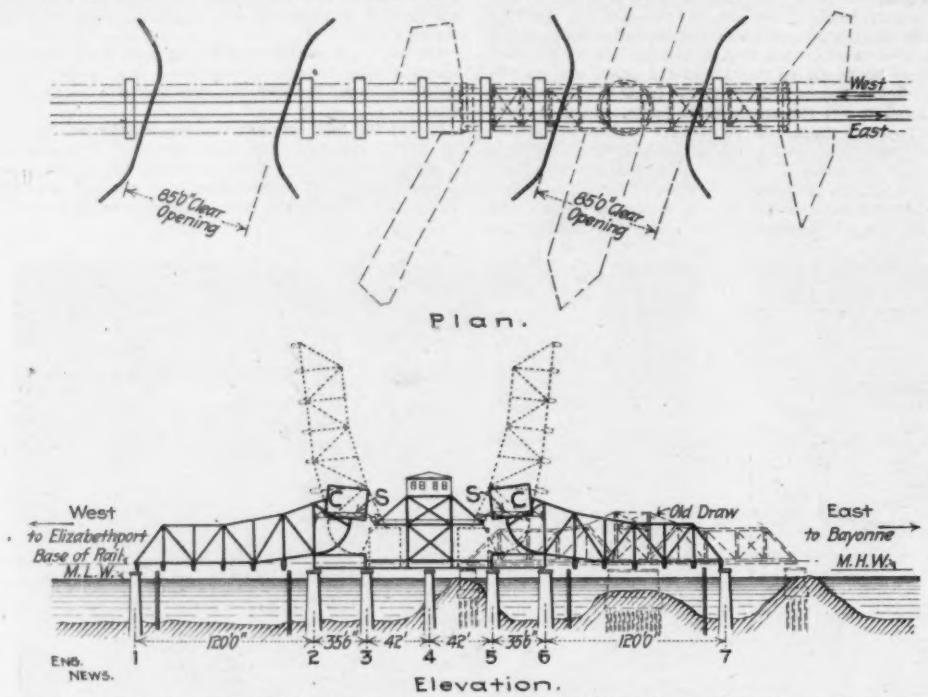


FIG. 1. DIAGRAM ELEVATION AND PLAN OF OLD AND NEW DRAW-BRIDGES, NEWARK BAY CROSSING, CENTRAL R. R. OF NEW JERSEY.

for the traffic it carries—the crossing is on the main line of the Central R. R. Co. of New Jersey and the Philadelphia & Reading Ry., ten miles from New York—and about three years ago plans were considered for replacing it with a bridge designed for modern engine and train loading. It happens that the center-pier and abutments of the old bridge were not adequate to carry the heavier bridge which would be required, so that it was necessary to provide not merely a new superstructure but also new foundations. It was therefore considered advisable to shift the channel for the new draw to one side of the old location, use the old channel and draw for navigation until the new structure was completed, and finally remove the old draw and replace it with trestle. The entire work was to be carried on with minimum interference with traffic.

The engineers of the railway company decided upon the Scherzer rolling-lift type for the new draw, on account of the facility which this type of bridge offers for erection with minimum interference to traffic, and also with a view to later widening to four-track, an operation which in the case of a swingbridge is attended with some complication. In this form of bridge no center pier is employed, so that each span forms only one channel as against the two channels formed by a swing bride; the shipping interests concerned in the Newark Bay channel insisted, however, that two separate channels be provided in the new drawbridge. This led to the arrangement shown in the accompanying diagrammatic elevation of the bridge (Fig. 1). Two Scherzer double-track through spans, each 120 ft. c. to c. of piers, but giving a net width of channel of only 85 ft. are arranged back to back, separated only far enough to allow of placing the operating house between them.

Both spans are operated from this house, by separate sets of gearing, which may be connected to a main jack shaft for either forward or reverse operation.

The new work thus comprises two entirely independent drawbridges. The duplication is maintained in the engine equipment. Two separate engines are provided, each of which is capable of operating either or both spans. The main jack shaft, to which each engine connects by friction coupling, is the only part of the operating equipment that is common to both spans.

The arrangement as noted made possible the erection of the new work in very simple manner, without interference with either railway or shipping traffic. The westerly half of the work was first taken in hand. The four westerly piers (Nos. 1 to 4 in Fig. 1) were built under the existing trestle work to the west of the old draw. The main stringers and segment track were placed on these piers and the west span was then built in the raised position, vertically in the air (see broken lines in Fig. 1), as is usual with this type of bridge. Floorbeams and stringers were put in position in the bridge, ready for the track. The bracing at the heel and between the counterweights was left out until the time of lowering the span, when it was bolted in place in a few hours, traffic being sent by way of Newark temporarily. Meanwhile the operating house had been built and the machinery placed, ready for operation. The operating-strut (S, Fig. 1) being put in gear with its pinion, the span was successfully lowered into horizontal position (on Sunday, Feb. 14, 1904), after the trestle occupying the channel of this span had been torn out. Ties and track were laid over the span and traffic over the crossing was resumed within twelve hours after interruption.

With one lift-span completed and in operation, the old draw may be permanently closed, piers 5, 6 and 7 constructed, and the easterly lift-span erected. The old draw will be taken down after a temporary trestle has been built under it to carry the track, the old center-pier and abutments removed and the easterly lift-span then lowered into position as was done with the west span. As may be seen from Fig. 1, the east span of the new bridge crosses the existing navigation channel, centrally with the old swingbridge.

Structurally, the new bridge (more strictly bridges) presents no great differences from other bridges of the Scherzer type, other than in the matter of general layout, already described. The line is double-track, and the two lift-spans, 120 ft. in span and trusses spaced 29 ft. apart c. to c., are correspondingly heavy. Roughly, the complete twin bridge weighs 2,000 tons, about half of which is in the cast-iron counterweights (C in Fig. 1). A general drawing of the bridge, Fig. 2, indicates the design of the principal parts. The operating house, as will be seen, has a rather short base, and carries a heavy cantilever frame at each end, on which the operating or rack pinion and its gear train are located. This gear train is driven from the main jack-shaft (in the machinery house) by an inclined bevel-gear shaft.

The new bridge is supported by solid concrete piers extending down to the bottom and there resting on piles driven to rock. Putting in these foundations was difficult and awkward work, since it had to be done under the old trestle (which has very small clearance above the water) and while trains were running. The foundation piles were driven through the trestle, on one side at a time, traffic being diverted to the other track temporarily. They were cut off at the level of the bottom, at a depth which varied for the different piers from 32 to 37 ft. For the construction of the piers, the contractor elected to employ the floating-cofferdam method, and it was therefore necessary to cut off the piles very accurately as to depth, which was satisfactorily accomplished. The cofferdams, built with removable sides, were then floated out to the site and the concreting of the piers begun inside them. When sunk far enough to go under the trestle, each cofferdam was pulled into place guided by suitably driven piling, and by admitting water was sunk to bearing on the foundation-piles. The concreting was then completed and the sides of the cofferdams removed.

The piers are of concrete to the top, without steel reinforcement except that a grillage of I-beams is molded in place in the top to form the bridge seats. No cutwater is provided; the piers are rectangular in cross-section up to about 3 ft. below the water line, above which level the ends are semicircular. The top is molded into coping form.

A noteworthy feature of this bridge is that it is operated by gasoline engines. Two 75-HP. engines are set on opposite sides of the machinery house, in line of a common jack-shaft to which both engines connect by friction-couplings. They are three-cylinder vertical engines, made by Fairbanks, Morse & Co. Due to the use of gas engines, the engine-room equipment is very simple. A small pump belted to the engine through a countershaft, and a cooling-tank, provide for the water-circulation.

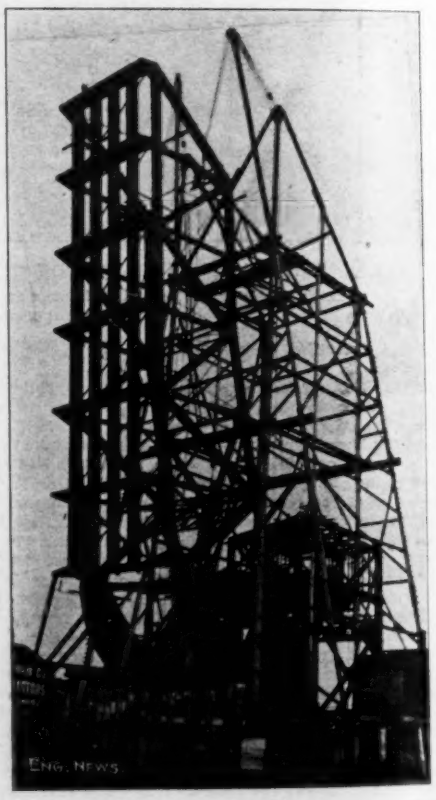


Fig. 3. Westerly Lift-Span During Erection, View Looking North.

The gasoline is stored in tanks on a metal platform built at one side of the house, below the floor-level. A light jib crane is pivoted to the frame over the platform, and its hoisting rope leads to a small hoist in the engine-room, belted to

the engine-shaft. This crane is intended for hoisting oil tanks and other supplies.

The construction of the bridge was interrupted by but one accident: in August, 1903, when the westerly lift-span was just begun, the erection traveler was blown over by a cyclone-like squall, killing several workmen. The accident delayed the work several months, which accounts for the fact that the first lift-span was completed and put into service in the middle of winter. The winter work in the exposed location of the bridge, with the bay ice-bound, was trying and slow, as will readily be understood.

The bridge was designed and constructed under the supervision of Mr. Jos. O. Osgood, Chief Engineer of the Central R. R. Co. of New Jersey. Mr. A. E. Owen is Division Engineer and Mr. H. Van Ness the Resident Engineer for the railway company. The substructure was built by Sandford & Harris, of Hoboken, N. J. The Pennsylvania Steel Co., of Steelton, Pa., fabricated and erected the superstructure, for which the Scherzer Rolling Lift Bridge Co., of Chicago, Ill., furnished the plans. The gearing and machinery other than engines was built by the Bethlehem Steel Co., of Bethlehem, Pa. Mr. E. B. Gumaer, of 39 Cortlandt St., New York, furnished and erected the machinery-house and fittings. We are indebted for the plans and information from which the preceding account was prepared to Mr. Austin Lord Bowman, of 29 Broadway, New York, Bridge Engineer for the Central R. R. of New Jersey, who is in charge of the work.

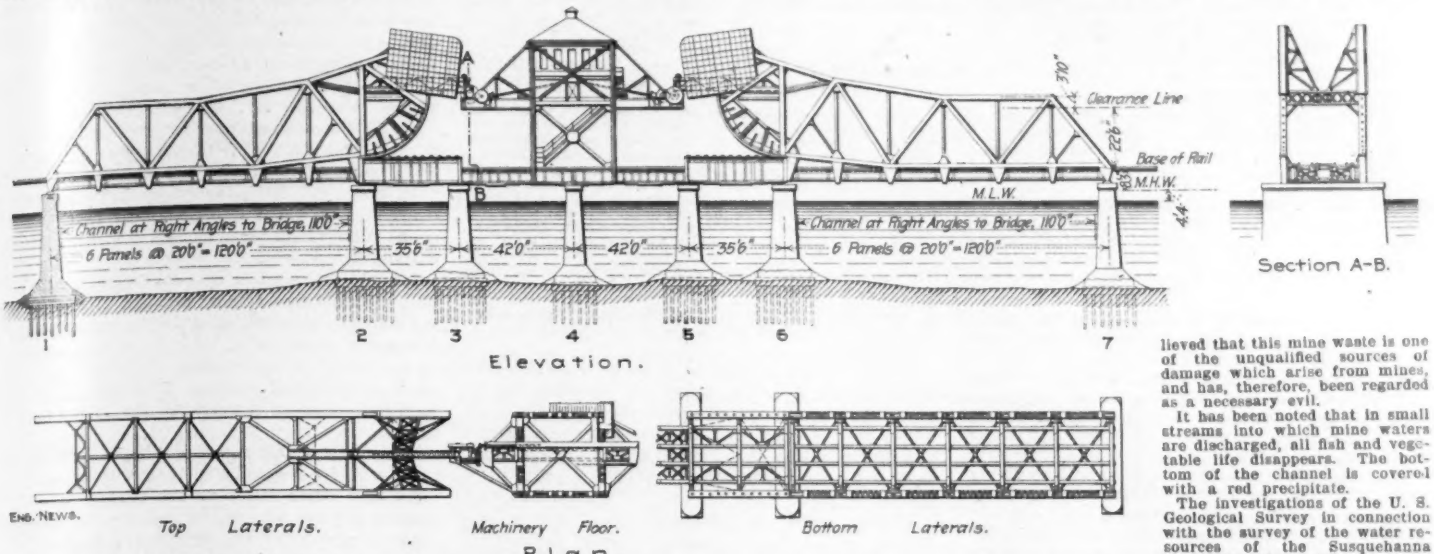


FIG. 2. GENERAL DRAWINGS OF NEW DRAW-SPANS, NEWARK BAY CROSSING, CENTRAL R. R. OF NEW JERSEY.

THE FACING OF CONCRETE WORK employed by the Wabash Ry. for bridge abutments of concrete and concrete-steel consists in applying a facing wash composed of 1 part of plaster-of-paris to 3 parts of cement, made very thin and put on with whitewash brushes. This has been found very satisfactory. The majority of the masonry work is done by contract and the application of this wash is included in the regular contract price per cubic yard.

THE MOST SERIOUS RAILWAY ACCIDENT of the week occurred on the Pennsylvania R. R., near Washington Crossing, N. J., on the Belvedere Division, on Feb. 17, 1904. A freight train had orders to take a siding so as to allow an opposing freight to pass. It disobeyed these orders and the trains collided. Two men were killed. Four months ago a rear collision at this same point caused over twenty deaths. Curiously enough, another fatal accident during the past week occurred at a place where several lives were lost in a train accident only a short time ago. A freight train on the Baltimore & Ohio Ry. ran away down a grade near Piedmont, W. Va., and finally went over a steep embankment. One of the trainmen was killed.

STREAM POLLUTION DAMAGES to the amount of $600 were awarded against the American Tin Plate Co., of Elwood, Ind., in the circuit court on Feb. 14. The damages were in favor of A. M. Moore, through whose farm flows a stream which receives wastes from the mill. Other suits against the same company are pending.

THE OFFICIAL RAILWAY ACCIDENT STATISTICS of the Interstate Commerce Commission for the quarter ending Oct. 1, 1903, show total casualties in train accidents as follows:

	Killed.	Injured.
Passengers	60	1,668
Employees	220	1,914
Total	280	3,582

Other accidents to employees and passengers not the result of train accidents bring the total number of casualties up to 15,187, being 109 passengers and 916 employees killed, and 2,688 passengers and 11,474 employees injured.

The total number of persons killed during this quarter shows an increase of 181; and the number killed in train accidents (280, as against 230) also shows an increase of 50 over the number reported killed in the preceding bulletin.

The number of employees killed in coupling and uncoupling cars was 70, being an increase of 8 over those reported in the preceding three months.

The total number of collisions and derailments was 3,063 (1,765 collisions and 1,298 derailments), of which 251 collisions and 140 derailments affected passenger trains. The damage to cars, engines and roadway by these accidents amounted to $2,470,375.

Fig. 4. Westerly Lift-Span During Erection, View Looking East.

THE EFFECT OF ACID COAL MINE WASTES on some of the Pennsylvania streams subjected to sewage pollution is described as follows in a note sent out by the Hydro-Economic Section of the U. S. Geological Survey:

One of the most troublesome features in connection with the development of mining property has been the discharge of mine waters into the streams and rivers. This has been particularly noticeable in the coal mining regions, especially those in Pennsylvania. Coal mine wastes contain large amounts of acids and other ingredients which affect the character of the water. It has been believed that this mine waste is one of the unqualified sources of damage which arise from mines, and has, therefore, been regarded as a necessary evil.

It has been noted that in small streams into which mine waters are discharged, all fish and vegetable life disappears. The bottom of the channel is covered with a red precipitate.

The investigations of the U. S. Geological Survey in connection with the survey of the water resources of the Susquehanna River show that, while there certainly are some disadvantages arising from the discharge of this mine water, there is, nevertheless, a large favorable factor. This mine water, which carries varying proportions of ferrous and aluminum sulphate, seems to be an ideal precipitating agent, and, while the character of the water into which it discharges is considered unfavorable in some respects, the benefits arising from the deposits of culm and organic matter more than compensates for the disadvantages, especially in the larger streams.

The investigations of the Survey show that the Susquehanna River just above the mouth of the Lackawanna at the entrance to the northern coal measures contain a considerable proportion of organic matter. Lackawanna River contributes to the Susquehanna immense amounts of sewage from the municipalities of Scranton, Carbondale, and smaller places, while below the entrance of the Lackawanna there is poured into the Susquehanna the sewage of Wilkesbarre, Pittston, West Pittston, Kingston, Plymouth and Nanticoke. In addition to this sewage, there is turned into the stream an unusually large quantity of fine coal dust. Such is the precipitating effect of the large quantities of acid mine waste turned into the Susquehanna from the shafts in the upper coal measures that the sewage water contains less putrescible matter at the Nanticoke dam, a short distance below the city of Nanticoke, than it does above the entrance of the sewers of the cities named. Enormous quantities of culm are also precipitated, except when the river is very high, and, on the whole, the water is as good from a chemical standpoint at Nanticoke as it is above the mouth of the Lackawanna. When one considers that the distance between these two points is 16 miles, and between them the river is subjected to the sewage pollution of 230,000 people, the beneficial effects of the acid mine wastes appear altogether remarkable.

COMPRESSED AIR FOR STREET-CAR AIR-BRAKES is usually supplied by a small electrically-driven air-compressor on the car. A different plan has been adopted by the St. Louis Transit Co., of St. Louis, Mo., which company is introducing the air-brake in place of the hand-brake on its cars. A compressor plant and air storage tank has been established at a point convenient to all cars on the lines that have been equipped with air-brakes. When the car reaches this point, a hose-connection is made from the storage tank to the car reservoir, and the latter is thus charged. It is said that only 15 seconds are needed to charge the reservoir. The pressure carried in the storage tank is 300 lbs., and the compressors are automatically thrown out when this point is reached. When the pressure drops to the car-reservoir pressure, the pumps are again started.

LOW WATER IN THE CITY RESERVOIR AT LAWrence, Mass., led the Massachusetts State Board of Health to send a letter to the Lawrence Water Board, on Feb. 17, advising the board to employ house-to-house inspectors and take all other possible means to avoid the necessity of supplying unfiltered water from the Merrimac River. If all other means of avoiding the use of untreated river water fail the State Board of Health suggests that it may be practicable to secure a temporary additional supply from the water-works of neighboring towns. It will be remembered by many that before the Lawrence filter was built the city suffered much from typhoid fever.

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According to the New York "Journal of Commerce" the municipal authorities propose to renew their application to the War Department for permission to build 1,000-ft. piers on the North River in the vicinity of 23d St. We quote as follows:

> This revival of an effort to get the sanction of the War Department for the extension of the pier head line was largely brought about by the Merchants' Association.
>
> The commercial interests of the city have expressed themselves in no uncertain tone regarding the matter, and steamship officials with practically one accord have looked upon the restriction of the pier head line to its present limits as an irreparable blow to the commerce and shipping interests of New York.

With all due respect to the Merchants' Association, we would suggest that before it proceeds farther in its campaign for 1,000-ft. docks, it would do well to have an impartial expert commission investigate the question whether the extension of the pier head line 200 ft. to accommodate steamships that may never be built is really for the best interests of the Port of New York.

A few weeks ago, in our issue of Dec. 31, we published the arguments of engineers on both sides of the question.* Without rehearsing these arguments here we may remark that a broad view of the interests of the Port of New York such as that reflected in the strong arguments of the New York Harbor Line Board against the proposed pier extension is worth the careful attention of the Merchants' Association, or of any individual or body which aims to promote efficient management of shipping and commerce in the Port of New York. New York's foreign commerce is absolutely dependent upon the efficient interchange of freight between the transportation routes, both land and water, which center here.

The enormous volume of harbor traffic concerned in New York's commerce, the present crowded condition of the harbor waterways, and the necessity for guarding against throttling of these channels,, have already been dwelt upon in the report referred to. We may, however, call attention to a related fact which is of primary bearing on the subject.

The Port of New York is peculiar in that most of its freight interchange is carried on by lighterage. The eight or nine trunk line railroads terminating on the New Jersey side, and the three roads on the New York side, interchange freight between themselves and with the shipping, as also with the city itself, by what is equivalent to drayage on water. The fleet of vessels: tugboats, barges, steam-lighters, car-floats, etc., engaged in this traffic is enormous. Nearly two score companies are in this lighterage business. Approximate figures are given in an interesting paper by Mr. A. J. Grymes, of the Erie R. R., on "Lighterage, its Advantages and Disadvantages to the Port of New York," read last week before the New York Railroad Club. Mr. Grymes says:

> There is no available record of the exact number of boats engaged in New York harbor lighterage business. The flotilla of the Erie R. R., independent of the passenger ferry boats, consists of 70 covered freight barges, 27 hand-hoist lighters, 3 steam-hoist lighters, 25 car-floats, 3 steam lighters, 2 live-stock boats, 410 harbor coal boats, 9 Sound coal boats, 12 coastwise coal barges, and 14 tugs, or a total of 575. Add to this the equipment owned by the Pennsylvania, New York Central, West Shore, Delaware Lackawanna & Western, Lehigh Valley, Central R. R. of New Jersey, Baltimore & Ohio, New York New Haven & Hartford, the Long Island, and the Ontario & Western railroads, and the thirty or more independent lighterage and towing companies, a conservative estimate will give us 1,000 vessels with steam and 9,000 without steam, making 10,000 craft operating in the waters of the Port of New York.

It may be added that in the seasons when terminal traffic is at its maximum, or when (as at present) there is great obstruction by ice, this whole fleet is busy, and, as was expressed in the discussion on the above-noted paper, "boats can't be had for love or money." With this great fleet plying in New York harbor, in addition to the coastwise, Sound and ocean shipping, and in addition to the busy passenger-ferry movement across the North and East Rivers, it is easily understood that there is hardly any safe margin for encroachment upon the width of navigation channels in the harbor.

The paper of Mr. Grymes gives some direct testimony on the crowded condition of the harbor traffic in New York as follows:

> A fact that is not generally understood is the importance of the duties of the steamboat pilot in New York harbor, with its ever-increasing traffic. We all know the responsibilities of the engine-driver, but they do not outweigh those of the steamboat man, either freight, passenger or tug-boat captain. With the ever-changing tides and winds and the relative position of his own in regard to many other craft, without an eagle eye, unerring judgment and iron nerve collisions would be inevitable.

And, in fact, collisions sometimes occur.

In order to clearly establish the relation of this lighterage movement to the movement of the large ocean vessels it is essential to observe further that, while many of the boats are small, the fleet as a whole is by no means a "mosquito fleet" which could readily dodge around the larger craft and thus make the ocean steamship the principal factor in determining channel room. Much of the lighterage is done in tows of two or four boats, a tug, for example, taking two barges on each side. Moreover, the latest car-floats are 300 ft. and even 330 ft. long, with a capacity of 12 to 20 loaded cars, and are heavy and cumbersome craft to handle.

A stronger indictment for neglect of the health and the very life of its citizens could not be framed against any city than that furnished by the records of typhoid fever at Pittsburg and Allegheny, Pa. These records, as printed in this issue, show the rate of typhoid mortality in Pittsburg for 31 years, and in more detail for both Pittsburg and Allegheny for over a dozen years.

These two cities have so long borne an evil reputation among sanitarians through their persistent neglect to provide a pure water supply and thus reduce their enormous typhoid mortality that it seems almost idle to comment further upon the shocking conditions which prevail in their midst. But it is not alone the people of these cities that are concerned. Pittsburg and Allegheny are centers of typhoid infection and as such they are a constant menace to the health of other parts of the country. Not only is their typhoid-infected sewage being carried down the Ohio River, but people from all over the United States and even more remote points are contracting typhoid fever in those hotbeds of the disease, and on returning to their homes they are scattering it far and wide. It is time for the press of the whole country to unite in a protest against the typhoid situation in these two cities. Self-destruction, bad as it is, might be overlooked, but wholesale murder must be put down.

If anyone thinks the foregoing words are exaggerated let him calmly examine the typhoid statistics of Pittsburg, Allegheny and vicinity and the descriptions of the public water supplies of those communities, which have been secured for this journal at no little trouble, and to which we devote a large amount of space in this issue. Over 7,000 deaths from typhoid fever have been recorded in Pittsburg alone during the last 31 years. For the last 14 years there have been some 30,000 cases of fever reported and over 1,200 deaths. In the year 1903 the same city showed 3,662 cases of fever and 474 deaths, and for the first 38 days of 1904, there were 516 cases and 69 deaths. And these figures do not take into account the typhoid fever carried elsewhere through Pittsburg's neglect!

The remedy for this evil condition at Pittsburg was proposed many years ago and after elaborate experiments plans for an adequate water purification plant were made, bids invited and construction almost put under way. At this point, however, political and mercenary interests intervened and succeeded in preventing the installation of filters.

Meanwhile Pittsburg and Allegheny distribute more water per capita to their citizens than almost any other cities in the country and have wasted and are wasting in this way an enormous amount of money; yet they will hear nothing of any measures to stop the waste. They even boast of their lavish supply of water as a proof of their greatness.

These are actual conditions; not theories. How long will the people of these cities continue to suffer under these conditions? When will they realize that efficient municipal government and safety of health, life and property of the citizen are indissolubly connected?

Mayor McClellan, of New York City, deserves all the commendation he is receiving for reviving and vigorously pushing the installation of a salt-water fire service in the business sections of this city, or south of 42d St. The experiment is by no means an untried one. The cities of Philadelphia, Boston, Detroit, Cleveland and Milwaukee are already equipped with a separate system of water supply for fire protection, and as late as 1900 the Merchants' Association of New York published a special engineering report upon an auxiliary salt-water supply for this city, and presented maps of parts of the Boroughs of Manhattan and Queens, showing the proposed installation of sea-water pipes, and accompanied these with a special plan for the protection of the Dry Goods District of Manhattan.

There are many reasons why such a service should be constructed at once, aside from the mere revival of interest in the matter occasioned by the late conflagration at Baltimore. The Island of Manhattan is long and narrow, and its comparatively low reservoirs are at one end of this strip. The result is that for the greater part of the city it is impossible to obtain by gravity a sufficient pressure at the hydrants to extinguish a fire. Our sole reliance now is upon our fire engines and upon such water supply as may reach lower New York through a long system of mains. To attempt to institute a high-pressure service for the lower section of the city would mean either an entirely separate system for fire service, or the remodeling of the present house fixtures to enable them to withstand the greatly increased pressure. On the other hand, New York, bounded as it is by great rivers on each side, is peculiarly well adapted for the installation of an auxiliary supply, taking its water from these rivers. Such a plan means pumping, but so does any plan for an adequate fire protection under present conditions.

Potable water is an expensive luxury in New York, and is very likely to become more so in the near future. And it hardly seems the part of wisdom to bring this good water many miles through very costly channels to pour it out on fires, in

*"The Proposed Extension of the North River Pier Head Line Near 23d St., New York City," containing reports on this subject by Mr. S. Whinery and by the New York Harbor Line Board of Engineer Officers; Eng. News, Dec. 31, 1903, p. 593 et seq.

cleaning streets and flushing sewers, when equally good water for these purposes runs by our door. The possible greater efficiency of a special and separate fire-pipe system can not be disputed. With pipes properly laid and the use of standpipes at convenient locations, a stationary pumping plant at the river's edge would send streams upon a fire that in volume and pressure would far surpass anything now available. Nor is the cost of such a separate system excessive. Mr. Foster Crowell, M. Am. Soc. C. E., the expert selected by the Merchants' Association, estimated that it would cost only $110,000 to introduce a full-powered fire-pipe system over the Dry Goods District of New York. This is an insignificant sum compared with the possible loss occasioned by a single fire in this district.

Salt water is more efficient mechanically in extinguishing a fire, owing to its greater density; and it vaporizes at a higher temperature, and its effect upon the fire is more intensified and prolonged. The objection one time made that it was more injurious to saturated merchandise than ordinary water is met by a denial from competent authorities and by the underwriters' experience. These objectors probably do not know that at the present time about one-third of all the water poured upon fires in this city in a year comes from the rivers, and is thus more or less salt water. And if sewage contamination is objected to, the intakes for the pumps can be so located as to use only clean sea water.

This same salt-water system would also furnish the supply necessary for a systematic street cleansing by water, to an extent that is now seemingly impossible where potable water is to be used for this purpose, but with great gain in the standard of cleanliness for our streets. Salt water for washing the streets and flushing sewers and gutters would be practically unlimited in volume, and would cost little more than the fuel and labor charges at the pumping station in its application. It has been also suggested for use in cooling the asphalt pavements of our city, that are now sometimes heated up to 125° F., and retain this heat throughout the night after an especially hot day. This use would enhance the comfort of many citizens and doubtless much decrease infant mortality in the crowded sections of the city.

Boston is the only city among those mentioned as having a separate fire-pipe system that uses salt water in these pipes. But after some years of experience there is no serious corrosion due to the contact of salt water with the pipes and valves. And while it is admitted that in time salt water will be comparatively more injurious to a cast-iron pipe system than fresh water would be, the greater safety from destruction by fire and the other possible uses suggested more than outweigh any possible cost of renewal.

For all of which reasons it is to be earnestly hoped that Mayor McClellan will persevere in his good work and impress the department heads and the Aldermen with the necessity of at once inaugurating so effective a system of further protecting the business of this city from possible untold loss.

A GOVERNMENT CEMENT-MAKING PLANT.

The construction of a great dam in the Salt River Valley, in Arizona, by the U. S. Reclamation Service, has raised some very interesting questions with reference to the extent to which the government is justified in competing with private industry.

The Tonto dam, as it is called, will be the largest masonry dam ever built. It is located at a point distant about 45 miles by wagon road from Globe, Arizona, and about 60 miles from Phoenix, the territory capital. At the outset the engineers perceived that the transportation of supplies was a most important element in estimating the cost of the completed structure, particularly with respect to the matter of cement.

It will be understood, of course, that the freight rates on cement brought from the East either by rail or by water would be entirely prohibitive and the number of Portland cement works in the West within reasonable distance of the dam site is limited. The nearest is the California Portland Cement Co., at Colton, 390 miles west of Phoenix by rail. From Colton to Globe by rail is 325 miles farther and the last 125 miles is over a branch line railway on which the average freight rates charged in 1902 were 4.36 cts. per ton-mile. From Globe to the site of the dam there is a wagon road; but between Phoenix and the dam site there extends a range of high mountains now crossed only by a rough trail.

There are two other Portland cement works in California, but they are located in the vicinity of San Francisco, so that the rail haul is 540 miles longer, making a total rail haul of 930 miles to Phoenix and 1,255 miles to Globe. The Portland cement works at Denver has a rail haul of 1,100 miles over the transcontinental line of the Atchison, Topeka & Santa Fe to reach Phoenix, and the only other works that may be considered as in the field of possible competition is that at Iola, Kan., nearly 1,500 miles by rail from Phoenix.

With the long rail haul, and the long and difficult wagon haul through an arid country at its end, the engineers were justified in concluding that the cost of cement laid down at the dam would be well-nigh prohibitive.

This would be the case even if there were actual competition among the different cement producers for the contract to furnish it. In view of the economic history of the past half dozen years, the engineers were entirely excusable for some doubt on this latter point. It will be seen that the single cement mill in Southern California has an advantage of 500 miles distance over any competitor, and that at most only three or possibly four other mills are near enough to be considered as possible bidders. All these mills, moreover, have had profitable markets for some time for all they could produce.

Under these circumstances an investigation was made of the rock in the vicinity of the dam site and a good quality of limestone was found with satisfactory clay beds not far away. Actual tests of these materials proved their suitability for cement manufacture and a rotary kiln cement plant was therefore purchased at a cost in the neighborhood of $100,000. Of course, the fuel supply would still have to be brought in from outside; but by using California petroleum it was estimated that not more than one barrel of oil would be consumed for each three barrels of cement manufactured, so that assuming the transportation rates on cement and oil to be the same, the freight bills for the cement to be used in the dam, roughly estimated at 200,000 barrels, would be reduced by about two-thirds.

As to whether this material would be brought in by way of Globe or by Phoenix, this is as yet an open question. The latter city being so much nearer the main source of supplies in California and a much larger place than Globe, is the natural source of supply for the large colony of workmen and others which will be engaged upon the work for the next four or five years. With this fact in mind, the government engineers have located a wagon road from Phoenix across the mountain range with maximum grades as low as 8%; and the county in which Phoenix is located is likely to undertake its construction.

However satisfactory the solution of their cement problem appeared to the engineers, it did not satisfy at all the cement manufacturers, and a formal protest was presented to the Interior Department, setting forth, among other things, that the government ought not to go into the manufacturing industry in competition with private producers. Secretary Hitchcock and his associates, however, refused to consider the matter from this point of view. They argued that the government was, in fact, a trustee for the future users of the stored water, who are eventually to pay for the irrigation works that are now being created. As such a trustee its sole duty is to see that the work is done in the best and most economical manner; and to pay more for cement than it could be made for at the dam site would be a fraud upon the future landowners who will use the stored water.

Practically the only argument left for the cement makers was the claim that they could furnish the cement on the site more cheaply than it could be made in the government mill, and they were assured that they should have an opportunity to prove this. To that end bids are now invited till Feb. 29, as recorded in our advertising columns, for the furnishing of "150,000 barrels or more of first-class Portland cement, delivered at the Tonto dam site;" and it will be of much interest to see what bids will be entered.

The difficulty in the way of making any really low bid will be evident. If we assume a price of $1.50 per barrel at the Southern California mill, 1 ct. per ton per mile for the rail haul and 20 cts. per ton-mile for the wagon haul, we have the following for the cost via Globe.

715 miles rail haul, per ton	$7.15
40 miles wagon haul	8.00
Cost of haul per ton	$15.15
Cost of haul per barrel	$3.03
Cost per barrel at mill	1.50
	$4.53

If the early construction of a wagon road from Phoenix can be counted on, we would have 325 miles less rail haul on the one hand and 20 miles longer wagon haul on the other. What difference this would make will depend, of course, on the actual cost of the rail and wagon haul, which may, of course, vary considerably from the figures assumed above.

But if the Southern California mill puts in a bid, it has no possible incentive at present apparent for reducing its figure at the dam below what the San Francisco and Denver producers could afford to furnish it for, which have to ship nearly 600 miles farther. Thus, even if free competition exists among the cement producers, the price at the dam is likely to be governed by the cost of shipment from these distant points. If we add the cost of 600 miles of rail shipment to the above, we have, assuming the same freight rate, a total probable minimum bid of $5.73 per barrel.

It may be said here that at past prices of cement at Globe and at Phoenix and past rates of charge for wagon hauling, an estimate of $9 per barrel as the cost of cement delivered at the dam site is said to have been about correct; and had the government omitted to fortify itself with its own cement plant, neither the cement producers, the railways nor the teamsters engaged in hauling would have had any particular incentive to reduce this figure. Considered as a business proposition, therefore, the cement plant at Tonto would appear to have been an admirable investment, even if it never makes a single barrel of cement and is sold for scrap after completion of the dam.

The question how far the government is justified in entering into competition with private producers in order to avoid the payment of monopoly prices is one which has occurred in other cases, and which is likely to occur even more frequently in the future than in the past.

It came up in a matter to which national attention was directed in connection with the contracts for armor plate. At first the government had to purchase all its armor plate from a single producer, the Bethlehem Co. Later the Carnegie Co. entered the field; but there was never real competition between the two concerns and an understanding existed between them as to their bids, as has, indeed, been recently testified in court, in the U. S. Shipbuilding litigation.

Recently a new competitor, the Midvale Steel Co., has entered the field and has taken one contract for armor plate; but it needs only the slightest acquaintance with business conditions to appreciate the fact that real and permanent competition can never be expected when only two or three competitors are involved. The way to a combination of interests, secret or open, is so easy and the profits resulting from such a course are so large that sooner or later such a combination is certain to be made.

It is worth consideration, whether the principle might not well be laid down that the government is justified in engaging in business whenever large amounts are involved and an extortionate monopoly price is exacted by private producers. Thus, if it were found that a combination of shipbuilding plants named excessive prices for building war vessels, the government would be justified in undertaking their construction in its own navy yards. If dredging contractors combine to name excessive prices on the deepening of river or harbor channels, there is no reason why the government should not operate its own

dredges, as in fact, it is now doing at many points.

It will be noted that we have limited the application of this principle to the cases where large amounts are involved. Of course, the government, like a private individual or a great corporation, has to pay excessive monopoly prices in numberless cases where it would be more expensive even to hunt up a new competitor than to pay the price asked.

Finally, with reference to the government cement-making plant at the Tonto dam, it is to be noted that it was not merely a threatened combination between cement producers which the government's engineers had to face. Even more important than this was the long distance over which the cement had to be brought by rail and wagon, and the strong probability that even with transportation charges reduced to their lowest possible figure, the cost of the cement from outside would exceed the cost of that made at the dam site.

From every point of view, therefore, the action of the Reclamation engineers in installing the Tonto cement plant appears deserving of high commendation. It was not only sound engineering but sound business; and, as we have recently remarked, the business aspects of an enterprise concern the engineer as much as the technical aspects.

LETTERS TO THE EDITOR.

Small Salaries of Engineers.

Sir: It seems to me there is too much outcry against offering small salaries to engineers in dull times. The writer has been Chief Engineer of several important lines, with liberal salaries; yet, owing to financial conditions of the work, he has frequently been compelled to receive and administer minimum salaries; and in "idle times" he would have accepted either of the positions so vehemently decried by correspondents in your issues of Jan. 28 and Feb. 11. Truly yours,

T. F. W.

Germantown, Pa., Feb. 12, 1904.

An Offer for a Mathematical Rodman.

Sir: Perhaps "H. S. M.," whose letter appears in your issue of Feb. 11, would be pleased to know the latest quotation on rodmen; here it is:

WANTED.—A rodman in a civil engineer's and surveyor's office; pay, besides the opportunity to learn the business, will average $18 per month; applicant must address, stating name, age, residence and inclose his personal full operation in solving the following problem by the use of logarithms: Given a triangle, angle opposite the given side 96 deg., 44 min., 38 sec.; another angle, 81 deg., 57 min., 4 sec.; side, 42.638; what are the other three parts?

Very truly yours, J. A. H.

Boston, Mass, Feb. 15, 1904.

Rules for Dropping Decimal Places.

Sir: Referring to A. H. Horton's communication upon this subject in your issue of Feb. 4, custom has established the rule that the 5 holds its place one decimal further to the right than the other figures.

According to the laws of chance, it will occur but once in ten times, and the increased accuracy in result is enough to compensate for the additional labor in computing the extra half.

And more than this, the 5 cannot be discriminated against except by an arbitrary ruling. Its value is as good to the odd as to the even number if it were ruled out of its place. Yours truly,

Ray S. Blinn.

Sparta, O., Feb. 10, 1904.

A Rule for Employees Belonging to Militia Organizations.

Sir: Enclosed please find copy of notice that we have recently posted in our works. We are doing this, believing that it is of mutual benefit to mankind, under existing circumstances. Yours truly,

The Vulcan Iron Works Co.,
Edw. L. Byron, for the President.

Toledo, Ohio, Feb. 13, 1904.

(The notice is as follows:—Ed.)

The Company will pay full time to any employee who is a member of the Ohio National Guard, when out on parade with their Company, at rifle practice, at camp duty, or when serving under the Governor or Sheriff to put down a riot.

The Surface Finish of Concrete.

Sir: On the subject of the appearance of exposed concrete walls and piers, it has been recommended that a little lamp black be used in the mixture. This gives the concrete a gray appearance and variations in color are not so apt to show as in the paler colors of ordinary concrete. Streaks of dirt are not so prominent on the gray as on the pale cement color. The lamp black would not wash out nor fade.

Professor Baker at the recent convention of the Illinois Society of Engineers and Surveyors referred to concrete structures on the Wabash Ry. which had been given a surface wash of cream made by mixing cement and plaster of paris, which gave a finish like marble. This would be pleasing and effective in clean localities.

The writer observed some work at Palos, Ala., where, after plastering the surface with cement mortar, the trowel marks were all removed by sweeping it with a small broom in a horizontal direction. The effect was to give the appearance of cut or sawed sandstone, and was a great improvement over the dead smooth finish.

In Rochester, N. Y., on some New York Central retaining walls the smooth surface is relieved by lines chiseled in a slanting direction, approaching the vertical. The lines are about two inches apart. This has the advantage of not being in imitation of anything.

Yours very truly, Edward Godfrey.

Monongahela Bank Bldg., Pittsburg, Pa., Feb. 6, 1904.

Hospital Air Locks for Caisson Disease.

Sir: In view of your article, "Deaths from Caisson Disease," published in your issue of Jan. 21, I herewith beg to enclose a paper read by me giving results of saving of life by the plan adopted which, is fully described herein.

I notice in your article that no lock was provided for re-immersing the men in compressed air when overcome, which method of treatment introduced by me on the Hudson Tunnel proved so efficient while I was in charge of this work.

The purity of the air and the slowness of the exit from the chamber are the two essentials, and the immediate re-immersion in a properly provided compartment in every case treated on the Hudson Tunnel proved efficacious. I am, Yours faithfully, E. W. Moir.

S. Pearson & Son, Limited, Contractors, 10 Victoria St., Westminster, S. W., London, Feb. 4, 1904.

(The Hudson Tunnel hospital designed by Mr. Moir was illustrated in our volume, January-June, 1890, p. 557. We may add that the latest investigations prove conclusively that this is emphatically the best and most effective method of treating caisson disease, and that slow reduction of pressure in the air lock on leaving work is the best preventive.—Ed.)

The Fire in the Masonic Temple and Changes in Tile Fireproofing Systems.

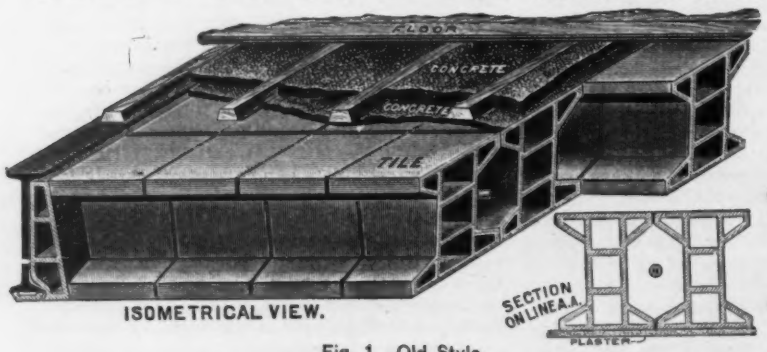
Sir: In your issue of Feb. 11, under the caption "Effect of a Fire in an Office," you illustrate the effect of fire on a ceiling of an office in the Masonic Temple at Chicago.

That building was erected somewhere about 20 years ago; the floors being of the then new end-construction and the material hard burned and dense hollow tile. We merely desire to refer to the above in order to show by the accompanying cuts the advance made in hollow-tile fireproofing since then. Fig. 1 represents the construction as employed in the Masonic Temple, and clearly shows the thinness of the webs and the large apertures in the blocks, the material itself being dense hollow tile.

Fig. 2 represents the construction of the present time and shows clearly the increased strength through decrease in the size of the holes in the blocks; increase in thickness of webs; protection of the lower flanges of the beams in the lip of the skewback; increased number of apertures in the blocks, adding to its strength and ability to resist fire and water; and, finally, the material is of porous terra cotta, a far better fire retardent than dense tile.

This latter construction was employed in the Safe Deposit & Trust Co.'s building at Baltimore, and judging from all reports has proven its right to be considered in the very first rank of fire resisting material.

New York, Feb. 16, 1904. "Veritas."



ISOMETRICAL VIEW.

Fig. 1. Old Style.

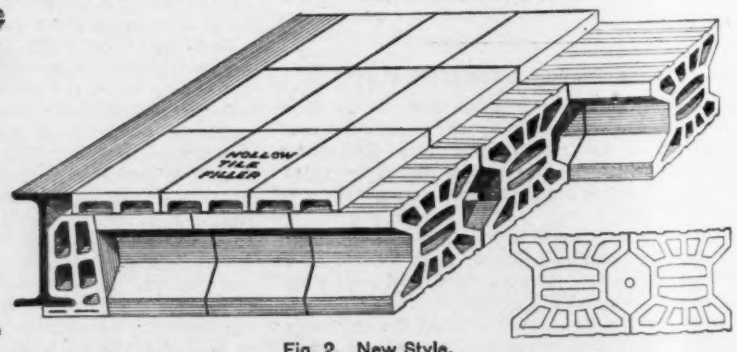


Fig. 2. New Style.

TWO TYPES OF HOLLOW TILE FIREPROOFING.

A Table Giving Quantities of Cement and Sand and of Cement Mortar for Sewer Pipe Joints.

Sir: In estimating quantities and cost of certain sewer construction, I attempted to secure data as to the amounts of cement and sand required for pipe-jointing, and I was rather surprised at the meager information contained in the text books, manufacturer's catalogues and other usual sources of reference. In the absence of specific and satisfactory statements along these lines, I have prepared the enclosed table, giving the theoretical proportions as determined from calculation of a right-angle joint, and annular socket space, which it might be of interest to publish with a view of securing more reliable data from engineers or contractors who have recorded the quantities used in actual practice.

Respectfully, J. N. Hazlehurst, M. Am. Soc. C. E.

Board of Public Works, Mobile, Ala., Feb. 10, 1904.

Quantities of Cement, Sand and of Cement Mortar for Sewer Pipe Joints.

For each 100 ft. of sewer (with Portland Cement 375 lbs. net per bbl.)

			Proportions: 1 Cement to 1 sand			1 Cement to 2 sand		
Size of pipe.	L'gth, ft.	Mortar, cu. yds.	Cement. bbls.	Sand, cu. yd.	No. bbl. cemt.	Cemt., bbls.	Sand, cu. yd.	No. ft. to bbl. cemt.
6-in.	2½	0.003	0.01248	0.00201	803	0.00855	0.00252	1,168
8-in.	2½	0.038	0.15808	0.02546	633	0.10830	0.03192	923
10-in.	2½	0.058	0.24128	0.03886	410	0.16530	0.04872	605
12-in.	2½	0.089	0.37024	0.05963	270	0.25365	0.07476	394
15-in.	2½	0.123	0.51268	0.08241	195	0.35055	0.10332	285
18-in.	2½	0.167	0.69472	0.11189	144	0.47595	0.14018	210
20-in.	2½	0.237	0.98592	0.15879	101	0.67545	0.19908	148
24-in.	2½	0.299	1.24384	0.20033	80	0.85215	0.25116	117
27-in.	3	0.492	2.04672	0.32964	49	1.40220	0.41328	71
30-in.	3	0.548	2.27968	0.36716	44	1.56180	0.46032	64
36-in.	3	0.849	3.53184	0.56883	29	2.41965	0.71316	41

Warnings Nine Years Ago Which, If Heeded, Might Have Averted the Columbus Typhoid Epidemic.

Sir: In reading your description of the typhoid fever epidemic in Columbus, O., and of the discharge of sewage from the State Hospital for the Insane into Dry Run, leading to the Scioto River above the intake, I remember the conditions as being those which I had seen in inspecting the premises in March, 1895. After that inspection I reported to the State Board of Health, as follows:

The sewage from the hospital is not ordinarily discharged into Dry Run . . . . . but instead is turned the other way, and together with the sewage from another institution is pumped into one of the city sewers entering the river below the city; and it is only through the occasional failure of the screens and outlets that sewage is dammed up in the sewer and overflows into the river. The drainage from a stable and from the laundry is discharged at a lower level through an old drain into Dry Run. This can be entirely avoided by building a new sewer at the lower level for a few hundred feet from the point where the sewage is collected from the hospital, and which is also near the laundry and stable, and from which

point there is ample fall to a point on the side of the hill where the sewage can be discharged into the sewer leading to the other institution. These changes can be made at an expense of a few hundred dollars.

In conclusion I reported that:

The water of the Scioto River in its unpurified state is not suitable for use as a public water supply,

and the findings of the State Board of Health in the premises in March, 1895, embodied this statement.

Very truly yours, Allen Hazen.

220 Broadway, New York City, Feb. 13, 1904.

(It seems almost incredible that these plain warnings should have gone practically unheeded for nine years, particularly the one relating to the hospital sewage, the danger from which could have been removed "at an expense of a few hundred dollars."—Ed.)

The Plow Test for Earthwork Classification.

Sir: I enclose herewith a diagram prepared some months ago, which is to some extent in line with your comments in a recent issue of Engineering News (Jan. 7), on classification of earthwork.

Where specifications for earthwork require the application of the six-horse plow test, and allow a percentage of loose rock in proportion to the difficulty in plowing, the engineer is often puzzled to know what percentage of loose rock will be equitable to both company and contractor.

The diagram is intended to give the percentage of loose rock in any output between the limits of 600 and 150 cu. yds. per day. The construction of the diagram will be understood from one or two examples:

600 cu. yds. earth excav. require 600 mins. = 1 cu. yd. in 1 min.

150 cu. yds. loose rock require 600 mins. = 1 cu. yd. in 4 mins.

For 66⅔% earth excavation and 33⅓% loose rock:

2 cu. yds. earth excavation	require	2 mins.
1 " " loose rock	"	4 "
3 cu yds. Total	require	6 mins.

∴ 300 cu. yds. total require 600 mins. = 1 day.

For 50% earth excavation and 50% loose rock:

1 cu. yd. earth excavation	requires	1 min.
1 " " loose rock	"	4 mins.
2 cu. yds. Total	requires	5 mins.

∴ 240 cu. yds. total requires 600 mins. = 1 day.

At first thought one might perhaps expect that an output of 375 cu. yds. per day, the average between all earth and

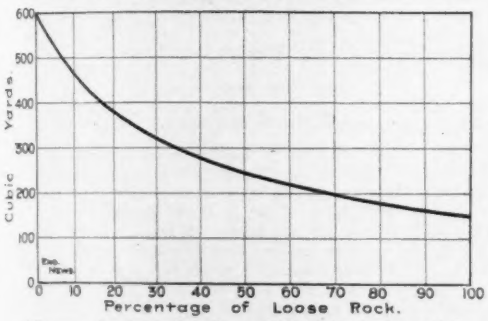


Diagram for Classification of Material Loosened by a Six-Horse Plow.

It is assumed that if six horses can plow 600 cubic yards per day (ten hours), the material is all earth, and that if six horses can plow only 150 cubic yards per day (ten hours), the material is all loose rock.

all loose rock, should be 50% loose rock. That it is in fact only 20% loose rock is evident from the diagram or from computation. It is of interest to note how rapidly the output decreases at the first suggestion of loose rock, and how slowly it decreases when the percentage of loose rock is anywhere near 100.

But whether the plow team is doing its full duty must still remain a matter for the exercise of the engineer's judgment, and is altogether beyond the scope of the diagram.

Yours truly,

John A. Fulton.

184 La Salle St., Chicago, Jan. 16, 1904.

The Architects' License Law in Illinois.

Sir: Referring to the letter of "Justus" in Engineering News, Jan. 28, the writer wishes to correct the idea that graduates of the University of Illinois are exempt from examination for an architect's license in the state of Illinois. The points made in the article in regard to the engineer's relations to building construction, however, are well taken.

Here is the exact standing that Illinois graduates have in this examination: Last June a test was made by which for one day out of the total of 2½ days the applicants were required to make three drawings (a front elevation and transverse and longitudinal sections) of a competitive library scheme which would have amounted to probably not less than $75,000 actual cost. Both architectural engineers and architects graduated from the University of Illinois were represented among the applicants for license. This first day the engineers had the task of going through a design of which they had no conception as to artistic features, while the architects handled it with ease. The second day was given up to an examination in heavy construction, covering all the features that are required to make a building conform to the laws of public safety. All graduates of the University of Illinois were exempt, if they chose, from this work.

The engineers, knowing the ignominious failure they must have made on the preceding day, when their artistic ignorance was exposed, of course took this examination, knowing that their only chance of securing a license depended upon their high standing in construction. The architects, knowing that their preceding day would credit them with a high figure and that their chances were small of benefiting themselves by taking this constructional work, took advantage of the feature of the law permitting them to be exempt, and occupied their time in preparing for the examination in specifications and a little light structural work which everybody had to take on the following half day.

One architect in particular received his degree from the University of Illinois in straight architecture less than a week before this examination. He had never had the slightest experience in an architect's office, having spent even his summers in traveling. He took advantage of his right to skip his examination in construction and passed the examination on the strength of his artistic ability and his degree. Less than a week ago the writer stepped into his office in another state, where he is doing business for himself, his permit to take out a license in the state of Illinois framed and hanging on the wall over his drafting board.

As far as the writer knows, no engineers failed in this examination, but is it any credit to the law that they did not?

Yours truly,

Louis F. Brayton.

St. Paul, Minn., Feb. 10, 1904.

The Attitude of Engineers Towards Water Meters.—Continued.

Sir: In your issue of Feb. 11 is a letter from Mr. Freeman C. Coffin, in which he takes exception to your editorial remark that engineers frequently recommended works for an additional water supply because that was "more attractive" than the idea of installing water meters.

I can not see that you have cast any slur on the engineering profession. To build a reservoir among the hills, forming a beautiful lake visible for miles around, to build an aqueduct stretching across the plain as far as the eye can see, all that appeals to the imagination. It is leaving a lasting monument to one's name, which corresponds very closely with the popular idea of glory. But to install meters in dirty, damp cellars, or on the mains under the streets, where they will never see the light of day, or be seen by an admiring multitude, that is an equally glorious work, but one more likely to lack appreciation by the public, or even by engineers. I do not mean to imply that engineers would consciously take such considerations into account, but since there is such a temptation, it would be small wonder if an engineer with the very best of intentions were prevented by its subtle influence from having a perfectly unbiased opinion.

While Mr. Coffin is a believer in meters, it does not seem to me that he puts the case nearly strong enough. Though admitting (what has been clearly proved) that the consumption in a well metered system, other conditions being the same, is much less than in an unmetered one, he suggests that there might be cases when metering would be undesirable.

In the case when a city was on the verge of a water famine, and there was need of obtaining immediate relief, the advantage appears still to be with installing meters, because their beneficial effect would begin as soon as the first meter was in place, or at latest, as soon as the first bill for water, based on the meter record, was rendered. But when additional works are built, there is not the slightest relief from a water famine until the works are completed and ready to deliver water, and that is a matter of several years of patient waiting.

There may be rare cases when the cost of building new works would be less than the cost of installing meters, but when the extra expenses due to an unnecessarily large consumption are considered the saving will be found to be more imaginary than real. Works for collecting water are not the whole of a water-works system; the distribution system is equally important. To avert a water famine by building additional works, and leaving the city unmetered, is to encourage waste, increase the consumption, and thus increase the size and cost of pumps and street mains; but to install meters is to decrease the cost of the distribution system.

There are two cases when meters might appear uneconomical. The per capita consumption of a city might be so low (say, below 50 gallons per capita, per day) that the introduction of meters would not produce any material reduction in consumption. Even then, on the principle that "An ounce of prevention is worth a pound of cure," it would be an eminently wise thing to put in meters.

Again, a private water company might have a contract with a city prescribing the flat rates to be charged, and the meter rates to be used in case the company installed meters. It is possible to imagine such a case in which the company would receive a higher price per 1,000 gallons for the unmetered water used (and wasted) under the flat rate, than they would be allowed to charge by meter. But even then, meters would be economical for the public.

As to the practical side of the question, the fact that the public and public officials are very often prejudiced against meters is no reason why an engineer should hesitate to recommend them. What is an engineer for? He is not an unskilled laborer, to do what he is told, but a professional man called in on account of his superior knowledge of the subject in hand; and a measure of his professional standing is the amount of confidence placed in his opinion. Even if the economy of water meters could not be demonstrated beyond a doubt (which is fortunately not the case) an engineer would show but little faith in his own convictions, who would, on that account, confine his recommendations to such as were susceptible of rigid proof. Yours truly,

Winslow H. Herschel.

Jerome Park Reservoir, New York City, Feb. 13, 1904.

The Relation of Snow to the June Rises of the Mississippi River.

Sir: In the paper of James F. Parr on "Floods and Flood Protection Works at East St. Louis," which was read at the annual meeting of the Illinois Society of Engineers and Surveyors, abstracts of which were given in your paper of Feb. 4, occurs one sentence to which the writer wishes to call attention. The sentence is:

The snows of the Rockies begin to melt in April and by the first of June are beginning to flow by us and give us what is locally known as the June rise.

There is usually some foundation for a popular belief that is well nigh universal. The writer has lived nine years on the banks of the Missouri and the lower Mississippi and he knows that the average resident of those sections believes in this theory of the June rise as he does in the Copernican theory itself. But since this seems to be one instance in which popular belief is wholly in error, this statement ought not to be allowed to pass uncorrected in an engineering journal.

The writer has been told informally by river engineers that the June rises have been known to occur after winters when there were almost no snows in the mountains, and they have been known not to occur after seasons when the snow fall was excessive. Other references to literature on the subject might be made, but perhaps the following quotation from the newly published work on "The Improvement of Rivers," by Thomas and Watt, will answer the purpose:

The melting snows, when unaccompanied by rains, rarely produce floods in large streams, notwithstanding popular opinion to the contrary. The deepest snows when melted make but a few inches of water, and this reaches the rivers gradually. At night the melting is reduced, or possibly stopped entirely, to be resumed again next day, but even if continuous, with the ground underneath frozen, an unusual condition in many localities, the quantity of run-off will not equal that of ordinary hard rains.

W. D. Taylor.

Madison, Wis., Feb. 10, 1904.

(In the late Major Wm. Starling's "Floods of the Mississippi River," printed in Engineering News of Jan. 30, 1896, and April 22, 29, and July 1, 1897, and since reprinted in pamphlet form, the author states:

The principal floods of the Missouri take place in May and June. The same causes which operate here to produce the rain serve also to melt the snow. With the southern tributaries of the Missouri and of the Mississippi the effects of the snow are inconsiderable. The Platte is said to derive some increments from this source. It is upon the streams which drain the Northern Slope, however, that the melting snows exert the most powerful influence. Rising directly upon the mountain sides, and having but a short distance to traverse, and that mostly through hard or clayey formations, these rivers are immediately and strongly affected by the liquefying of the snow-caps which crown the northern peaks, though, as may be seen, the rain, which is now in its greatest abundance, is an agent of prime importance in producing the floods.

There are sometimes early spring rises in the upper Missouri from the melting of snow alone, and there are often floods in the lower part of the valley from rains.

Discussing more specifically the question at issue, Mr. Starling said:

THE INFLUENCE OF SNOWFALL AND RAINFALL UPON FLOODS.

It is often affirmed that the principal cause of floods is the melting of the winter's ice and snow. This opinion seems to have a strong hold on the popular mind, and is entertained even by many intelligent people. It is no doubt founded on the imposing and often-observed phenomena of mountain streams. As applied to rivers, the greater part of whose course lies in the lowlands, it may without question be pronounced erroneous. In the case of the Ohio it is well known that some of the greatest floods ever recorded have occurred when there was little snow on the ground. On the other hand, some of the heaviest

snowfalls have disappeared by gradual thawing, without rain, and made but a trifling and evanescent impression on the rivers. The most potent agent in producing floods has been excessive rainfall. In making this assertion, it is not intended to exclude the action of snow where it exists. On the contrary, the latter co-operates powerfully with the rain. A deep snow, passing off with a warm and heavy rain, of course greatly augments the effect of the latter, and that, too, at a very critical time. It is true that a foot of snow is only equal to an inch of rain, but when the rain is considerable, every fraction of an inch increases its effective volume for drainage more than proportionately. For instance, in a dry season, an inch of rain will not much more than be absorbed by the ground, especially if it fall slowly, but if two inches fall, the additional inch will nearly all turn to drainage, and of three inches two will be turned into the rivers. Thus a three-inch rain will be doubly as effective as one of two inches, and infinitely more powerful than one of a single inch. Especially will this remark hold good if the downfall be violent and concentrated in a short time. It is obvious that snow acts almost instantaneously to increase the volume of "run-off."

On the whole, Mr. Starling seems to be in agreement with Professor Taylor and the authority quoted by the latter, but, on the other hand, he seems to make the snow responsible for a portion, at least, of the June rise.—Ed.)

The Quality of the Underground Water Supply at Albion, N. Y., as Affected by Infiltrated Canal Water.

Sir: The enclosed newspaper clipping is submitted as giving an illustration of the management of small water supplies. The incompetency often displayed in the design of a system is equaled only by the indifference to the public welfare in its later management. After a supply has been proven contaminated, and the health of a community not only threatened but actually assailed, the lack of intelligent effort on the part of the community could not be greater if it consisted of a collection of South Africans who had never read a newspaper and learned of such examples as Ithaca and Butler.

The notice issued by the superintendent of the Albion Water-Works Co. is unique and would be humorous were it not for the grave issues involved. This ingenious person states that he wishes to correct many errors afloat regarding the use of Erie Canal water in the village supply; and then he proceeds to show that there are no errors whatever afloat, but only the simple truth. He is a most fortunate superintendent, for no sooner does he require a filter bed as an adjunct to his water-works system, than he finds one ready made "of natural earth composed of fine sand, quicksand and gravel." He has also strengthened his position by taking the advice of the large taxpayers who prefer fire protection to health protection. A promise is made to secure a larger supply next season, but meanwhile it would be advisable for the citizens of Albion to boil the water.

One statement is especially suggestive: "It has been hinted that the company was depending on the canal." If the company, in order to maintain fire protection and acting under the advice of taxpayers, was forced by what it considered satisfactory reasons to supplement its supply with canal water, why was the fact not openly stated, so that consumers might have the option of taking some precautionary measures? Instead of doing this the matter was kept secret until it percolated the public mind by rumors. This is a sinister feature that too often appears in cases of a contaminated water supply; the water company being the last instead of the first in a community to call public attention to needed measures of self-protection.

Albion is in an unfortunate situation if it is compelled to experiment with canal water, even for a short period. A long series of experiments in that direction have been carried on by the water company in the neighboring village of Medina, and the results as established by the death rate have been amply conclusive. The town only recently has compelled the company, after years of agitation, to cease pumping canal water into the mains. The Medina Water Co. was not so fortunate as to discover a ready-made filter bed.

It would appear as though Albion were in need of active intervention by the State Board of Health. Analyses of samples of water establish certain facts regarding those particular samples, but an inspection of the efficiency of the automatic, ready-made filter bed is in order, with special reference as to how long it can remain in commission without cleaning, and to what extent it is already polluted by surface drainage.

Yours respectfully, G. C. Mills.

Rochester, N. Y., Jan. 7, 1904.

(The clipping referred to is a press dispatch to the Rochester "Post Express," dated Albion, Jan. 2. The dispatch opens with a reference to an analysis of canal water made by the State Board of Health at the request of the local health officers. The report on the analysis stated that the water was of "very excellent quality" and that there need be no fear that "impure water from the canal contaminated the water supply." The wells in question are described as drilled wells in the dispatch, and in "The Municipal Year Book" for 1902 as driven wells. The following "notice to the public" regarding the supply from the canal and its infiltration through sand to the wells, is credited in the dispatch to Mr. Oscar D. Eddy, Superintendent of the Albion Water-Works Co.:

We wish to correct many errors that are afloat about town as to our use of canal water at our pumping station. We have tried our best to keep up fire protection without the use of canal water for the past two months, but the springs and wells were so low that it was an impossibility. Instead of getting better they continued lower and lower. By the advice of many of the large taxpayers of the village we turned on the canal water into our pond and let it filter through the land. We did so Dec. 21. That did not help us any until Dec. 27, when it commenced to raise our wells to a small extent.

None of this water gets into the wells only as it filters through from 60 to 75 ft. of natural earth composed of fine sand, quicksand and gravel. We are obliged to keep up fire protection the first thing we do. The company will prospect and get a larger supply of water next season if they have to go to the lake for it. I have had a talk with Dr. A. E. Wage, Health Officer, about sending more of the water away for analysis and we expect to do so to-day. When we get the returns we will let you know how it is.

Since in our opinion the case against the character of the water, as above stated, is by no means proven, we submitted the foregoing letter and quotation to Mr. Eddy, with a request for more specific information. This Mr. Eddy, in reply, failed to give. Mr. Eddy states, however, that he "never turned on the canal until the public was notified," and that two analyses of the water supplied by the company have been made by the State Board of Health, and the water pronounced good. In conclusion, we may say that it seems quite possible that canal water, after passing through the ground for the distance named, and at the very slow rate indicated, might be of a very satisfactory character. Like all public water supplies, water obtained under such conditions should be systematically and frequently analyzed by some competent person.—Ed.)

The Closed Profession Idea in the Canadian Society of Civil Engineers.

Sir: Referring to the published report, in your issue of Feb. 4, of the meeting of the Canadian Society of Civil Engineers, which was recently held in Montreal, it appears to the writer that you convey the mistaken idea that the said society is unanimous in the attempt to make engineering a closed profession in Canada.

I attended the meeting referred to by your representative, and am not altogether surprised that he should be impressed with that idea, for the "closed profession" question was discussed "boldly and fearlessly," as one speaker characterized it. The new doctrine, or to speak more correctly, the old and true doctrine, of the closed profession advocate was certainly presented in its true colors, and apparently received in an unanimous spirit, but I am proud to be able to say that not a single engineer voiced approval of the idea and the cheering was apparently done by the land surveyors and some of the younger members of the society who constituted the majority of those present at the dinner. The slogan was: "Canada for the Canadians and higher wages for the engineers by making the profession a closed one." Is it a wonder that the students cheered? There was not the least attempt to disguise the doctrine by any allusions to the old shield, namely, "the noble attempt to elevate the standing of the profession."

Now, it is generally conceded that nothing could be more noble or godlike than the mottoes: Benevolence, Mutual Benefits, Sobriety, Social Advancement, etc., laid down in the constitutions of all labor unions. But how many of these unions live up to their expressed mottoes? How many engineers have had their work delayed or totally closed down by the walking delegate? Do those engineers, because the mottoes of the unions are good, because the principle may be correct, and because the individual laborer is almost always in the right—I repeat, do those engineers approve of the walking delegate and the practical working of these unions? If not, are they going to further complicate matters by forming a high-class and more distasteful union than has yet been known?

To be plain, let us suppose that the Canadian Sodality of Combined Employees and United Order of Peg Setters are able to have laws epacted making it an illegal and punishable offense for any but a member of said union to set a peg. Are they not accomplishing by law what the Amalgamated United Brotherhood of Post Hole Diggers have been trying to accomplish by force, and will not the latter also demand, and with justice, that similar laws be enacted for their benefit?

The advocate of the closed profession will claim that my comparisons are not fair and will attempt to clinch his case by the old worn-out allusion to two other great professions; but there are very good reasons why what apparently works satisfactorily in their case will not apply to the profession of engineering. The members of the learned profession are dealing directly with the health of the people, and the latter will always uphold any law that may be enacted if the excuse is given that it is for the elevation of the profession. As considerable of their work lies under cover, and as there is more or less mystery surrounding the same, it can be safely assumed that that profession will remain a closed one.

While it has been said that the members of all professions are parasites I am sure that the world from this standpoint does not place the engineers in the same class as the less modest and self-styled *honorable* and learned profession. When I think of the usefulness of that great profession it is always in connection with the story of the farmer who emigrated to Kansas some years ago about the same time the grasshoppers did. The first year he raised a little, the second year he did not do as well, and the third year he raised what the writer considers the greatest production of the said legal profession. Its adherents make the laws, they interpret the laws and they live by the laws, therefore what will apply to their profession will not apply to the engineers. Though the latter may have laws enacted, if these laws do not meet with the approval of the people or of corporations, a means of evading them will easily be found.

But the writer believes that the strongest argument against a closed profession as recently outlined is its undesirability from a Canadian standpoint. To-day the field of the engineer is practically unlimited. What do we find as a result? Men from all over the world working on the same piece of work. Does this international intercourse not tend to elevate the profession? We do not find one engineer in ten working in the locality of his birthplace; on the other hand, we do not find one in ten of other (closed) professions away from their birthplaces. The result is that the young engineer does not have to undergo a staryation period. He does not have to start doing the drudgery work of other professions in order to get a foothold; he simply goes where his services are required. While the writer has not the appropriate statistics on hand, he believes that for every foreign-born engineer working in prosperous Canada to-day you will find five Canadian-born engineers working in foreign countries.

When all the world is working on a free trade basis in engineering service can Canada afford to put an import duty on a commodity which it is largely exporting? The writer thinks not, and he further believes that the majority of the members (full members) of the Canadian Society of Civil Engineers are too farseeing and too broad-minded to desire any such combination as was outlined at their annual dinner. J. G. S., M. Can. Soc. C. E.

Winnipeg, Man., Feb. 6, 1904.

Sentiment or Finance.

Sir: So far, it appears to me that nearly all opposition to the acceptance of the Carnegie gift to the engineering societies for a unity building is based on sentiment. The fear that the identity of the American Society might be marred seems to pervade the whole negative argument. To me the question resolves itself into a purely financial one, i. e., whether the portion of the cost of maintenance of the proposed structure would be in excess of the amount expended in defraying the expenses of the present institution.

Aside from this I am of the opinion that the proposition is one to be accepted with avidity. Respectfully,

Emmet Steece, Assoc. M. Am. Soc. C. E.

Burlington, Iowa, Feb. 15, 1904.

What Shall Its Name Be?

Sir: If we are to have a building in New York City for the joint occupancy of the four American Engineering Societies (and I trust we may have), I hope it will not be designated in any way as a "Union Building."

If it is called a "Union Building," it is quite possible that stationary engineers, steam fitters, plumbers, or the like, may occasionally mistake it for the union headquarters of their respective crafts!

There may be nothing but sentiment in this matter, but after all there has been, it seems to me, more sentiment than anything else in the discussion regarding the acceptance by the American Society of Civil Engineers of Mr. Carnegie's very generous offer.

Why not call the proposed building "The Building of the American Engineering Societies?" Yours truly,

C. F. Loweth.

1100 Old Colony Building, Chicago, Feb. 15, 1904.

(Would not a briefer and better name be that suggested by Mr. John Thomson, M. Am. Soc. C. E., in our issue of June 4 last. We quote as follows:

Let us draft the title like a generic patent claim, inclusive of all future amendments or modifications: THE ENGINEERING BUILDING OF AMERICA.

The Board of Direction and the Building.

Sir: I notice that the use of an outside room for the Annual Meeting of the American Society of Civil Engineers has been construed as a point in favor of accepting Mr. Carnegie's very generous proposition, yet I think that it would be quite as fair to infer that this unusual move on the part of the management is but another instance of their careful attention and correct estimate of our needs. We have been particularly fortunate in that we have always been well guided. Our leaders have invariably caged our requirements. The policy evolved by the Direction of the American Society of Civil Engineers has resulted in its present success. It is usual to infer that officers are in possession of more complete knowledge than others. So long as we must vote upon this matter, we would do well to follow the suggestion so unmistakably recorded in the recent circular and give due weight to the adverse opinion of those who are so disinterestedly serving us.

The situation is one that must be considered from two distinct standpoints; there is a professional side and also a financial side. The chief end of a scientific society cannot well be a financial one, and members would do well to ask themselves whether they would really vote for this proposition if it were not for the pecuniary gain that is supposed to be obtained by it. As to this last, it should be remembered that the entire sum promised by Mr. Carnegie does not come to us. We profit only by one-fourth of the amount, and against this we must sell or mortgage our own building so as to provide money for our share of the purchase of the new lots. Our net gain is, therefore, much less than even one-fourth of the sum in question, and it is the net gain that must be considered. In this connection I would ask attention to the very able resumés of Mr. Odell and "A Member," as printed in your Feb. 4 issue. The several branches of our profession must eventually come into closer contact, but it is an open question whether such a combination can be prematurely forced on a financial basis.

Aside from net money benefit—considerably less than one-fourth of the sum offered by Mr. Carnegie—participation in this plan would mean a complete change in our policy, and, as stated in a recent circular, "an utterly unknown future." It is hoped, therefore, that members, particularly those at a distance, will consider carefully before they vote, and it is not out of place to urge due respect for the official conclusions set forth by Directors with inside knowledge, and here upon the ground.

Yours very truly, Chas. H. Snow.

New York University, New York City, Feb. 15, 1904.

Favoring a Broad and Liberal Policy.

Sir: Referring to the pending vote by the American Society of Civil Engineers upon accepting its share of the new building so generously offered by Mr. Carnegie, it is earnestly to be hoped that each voter who feels at all doubtful will err upon the side of a broad and liberal policy for the engineering profession in general, rather than to take a narrow view based upon his personal society affiliation.

The writer, who happens to hold membership in all four of the great National Societies, as well as the Engineers' Club, and whose acquaintanceship is pretty well distributed among the different organizations, feels perhaps more strongly than some others the necessity of a closer and increasing spirit of brotherhood, as time goes on, among the different branches of the profession.

The objection that has been made to the Engineers' Club forming the fifth party to the proposed geographical collaboration, so to speak, is of no force whatever, as its new building will simply be adjacent to the other, and very conveniently so, if certain doorways should be cut through between the buildings. Otherwise, its organization is absolutely independent of the Societies, and it may be considered only a happy accident that Mr. Carnegie should have showered some of his munificence upon the Club at the same time as upon the Societies.

To a few of us who, a dozen or so years ago, attempted to bring about a feeling in favor of a joint engineering building, but who found the field not yet ripe (either financially or otherwise) for such a harvest, the present movement is extremely gratifying. It is true that it does not entirely come up to our ideals for a splendid architectural monument upon Fifth Avenue, occupying a whole block in width, in which should be congregated headquarters for all the engineering and many other scientific societies, including perhaps the Institute of Architects. This was, and is perhaps, too much to hope for in the present generation. The pending movement, however, is a long step toward the fulfillment of such an ideal, and will answer the purpose for many years to come of educating us for and of bringing about that co-operation among all branches of engineering which will add greatly to the glory and honor of the profession, as well as to the value and profit of its work.

As the facts now stand, it would seem that practically all the membership of three of the Societies in question are in favor of accepting this splendid gift, as are also a large number of the Civil Engineers. With those who are not so in favor, the principal objection to the new movement seems to be a sentimental one—the love of living quietly in their new and beautiful, but somewhat remote, home with their old associates, who happen to have been following most closely the same lines of work. This personal preference it is to be hoped some of them will be willing to waive in the interests of the engineering guild at large, by changing their votes within the next few days, if it happens they have already voted.

Outside of sentiment, the chief practical disadvantage of the new movement seems to be the abandoning of the home on 57th St. at, as some claim, a possible pecuniary loss. Such loss, however, is not probable, as good real estate in New York is not a cheap article, nor likely to be.

A great advantage, apparent to every one, is the attainment of a large auditorium, for use at any desired time, without going away several blocks and hiring halls, both for conventions and for social purposes, as the Societies are all now obliged to do—not excepting the Civil Engineers.

Those engineers who cling so fondly to the adjective "Civil" as covering all fields of professional work should remember that the term is in any event but a misnomer, originally applied to those men who made roads, bridges and water-conduits, which were not for military purposes. In these days the Military (and Naval) engineers are inextricably mixed with almost all other branches of the profession, in outdoor topographical work, in machine shops for small-arms manufacturing, in cartridge making and in ship and gun building, as well as in the making and handling of a great variety of electrical appliances, etc. On the other hand, the men following so-called civil engineering are so closely identified in much of their work with mechanical and electrical operations, starting with the products of the mining engineer and finishing by furnishing him with his tools, that it is very difficult to separate and classify the numerous specialized branches of the profession. Out of the resulting confusion of nomenclature there seems no logical way but to use the plain term "Engineer" to properly designate the members of the great guild which is advancing our present marvelous civilization by leaps and bounds.

If the American Society of Civil Engineers wishes and expects to cover the whole broad field of engineering, as it professes to, why should it be so narrow as to want to live in a small house by itself, and expect people who are now banded in groups for various specialized work to come to it, rather than join in a magnificent new house large enough for all?

That this Society is obliged to cover a very large field of work outside of what used to be known as merely civil engineering is unquestionable. That it wishes to cover it is instanced, among other things, by a recent circular mentioning that the coming Engineering Congress at St. Louis, open to all branches of the profession over the whole world, is to be conducted under its auspices. This is eminently proper, if it really is the broad-minded Society that it ought to be, and that the British Institution of Civil Engineers actually is. In such case it cannot by any means afford to be clannish to the extent of living by itself, and being afraid of a warmer friendship and a closer affiliation with the great mass of engineers who are acting with it, and with all of whose work it is so closely intermingled.

If we, the members of this Society, now decide by our vote to stay "out in the cold," there is no question but what in the coming years of the glorified center of National Engineering in the vicinity of Fifth Avenue and 39th Street, we will find that we are *left* out in the cold.

Oberlin Smith.

Bridgeton, N. J., Feb. 22, 1904.

Specialists and Engineers.

Sir: To one who has watched the growth of the American Society of Civil Engineers since its resuscitation in 1867, and its admirable, conservative management, any departure from such management demands most careful examination and convincing reasons to warrant its adoption.

Mr. Carnegie offers to erect, on land to be purchased from him by the societies in question, and for their common use, a building costing a million and a half of dollars. The proposed gift is princely, and can only inspire feelings of gratitude to, and respect for, Mr. Carnegie, and admiration of his example of great wealth devoted to beneficent purposes.

Is there not danger, however, that this gratitude and admiration, and the magnificence of the proposed gift, may dazzle our imagination and, by comparison, belittle our present position?

The equity in our present building was, on Jan. 1, this year, $136,730. The cost of the land we should have to purchase from Mr. Carnegie, plus interest for the time he holds it, would amount to almost exactly this sum. Consequently our assets upon moving to the Union Building will be only an undivided interest in the million-and-a-half-dollar building.

Undoubtedly the running expenses, or rather our share of them, will be greater in the new building, with its greater height, than we are subject to at present.

Possibly this would be offset by our share of the rental of spare room in the building for offices. If we rent a portion of our Union Building for profit, will not the building be taxed as a business building at least $20,000 a year, and will we not revert to our early condition of occupying rooms in a business building?

By housing the four engineering societies in one building can we be sure of uniting all branches of the profession? Are we to believe that these four societies will monopolize all classes of engineers? Will not engineering in general become more and more specialized and require new societies representing these specialties? Why should we not expect societies representing hydraulic engineering, sanitary engineering, bridge engineering, municipal engineering, naval engineering, dock engineering, etc., etc.? Could all such orgaizations be accommodated in the proposed Union Building, and would they be content to pay rent to the constituent societies?

The American Society of Civil Engineers is unique in its position. It represents engineering in general in its broadest, highest sense. It fosters no specialty of engineering. Its membership denotes distinction, not merely a chosen branch of the profession. All the other societies in question are bodies of specialists, with membership drawn in many cases from the parent, or general, society. Very properly they limit their interests to some one branch of engineering and admit, or should admit, men qualified only to practice in their specialty. Consequently their standards of admission are not on the broad lines of the American Society of Civil Engineers.

We should certainly lose leadership and individuality in the eyes of the world by becoming equal partners in a common engineering building.

Let us continue the broad, dignified and conservative conditions of the past, self-supporting and independent, occupying exclusively the beautiful and adequate building now known as the House of the American Society of Civil Engineers, rather than become one of the specialist engineering societies occupying rooms in the "Carnegie Engineering Building."

Edgar B. Van Winkle, M. Am. Soc. C. E.

New York, Feb. 20, 1904.

(The above letter was sent as a circular to the members of the American Society of Civil Engineers and has been somewhat condensed for publication here.—Ed.)

Objects to Entangling Alliances.

Sir: I avail myself of your offer in the issue of Jan. 28 and subjoin a few more suggestions in reference to the erection of that Joint Engineering Building. At the date of my communication, read at the annual meeting of the American Society of Civil Engineers (which you were kind enough to publish in condensed form), the circular of Jan. 16, of the Board of Direction, had not been received, giving the details of the proposition of Mr. Andrew Carnegie. These details give a somewhat different phase to the subject from what was my understanding at the date of the convention at Asheville, N. C.

The offer of Mr. Carnegie is plain and business-like. It is best that he should control the erection of the building, and it is only in consonance with the requirements in all his benefactions that the beneficiaries should advance a portion of the expense. It is in dividing these benefits among the five constituent societies that the difficulties present themselves.

The arguments for and against the policy of the American Society of Civil Engineers entering into this proposed combination are very ably and convincingly set forth in the circular of Jan. 16, by its Board of Direction, and I only wish to call attention to a few objections presenting themselves that appear not to be emphasized sufficiently.

The Conference Committee of the four societies in their program have failed to apportion the amount of bonds to be purchased by each society. On an equal division there would fall to each practically $140,000 of these bonds. To meet this adjudication the American Society of Civil Engineers would be compelled to sell their present headquarters on 57th St. and invest the proceeds in securities over which they have no control, except by a vote of one to four or five. It occurs to me that a legal question arises here. Has this society, by its charter, the power to legally consummate such a sale? It is questionable.

Another legal question has been brought forward by Mr. E. P. North and is alluded to by the Board of Direction: Suppose the society, from any cause, wishes to withdraw from this joint ownership, can it do so without forfeiting its rights and all its assets originally paid in? These bonds can be called in with a six months' notice. Suppose any one of these societies are unable to meet these summary demands either for principal or interest; the usual course of law would be the summary ejectment of the delinquent. As long as human nature remains as it is, internal dissensions and jealousies are liable to arise and may reach such a pitch as to make it desirable for any one society to withdraw, yet it cannot do so without the forfeiture of its rights and assets.

These are a few of the objections that present themselves to me adverse to the consummation of this copartnership, and are so grave as to convince me that the American Society of Civil Engineers with its present information should decline to join its fortunes to this executive corporation.

In my former communication it was asserted that at present the society needs no more extensive quarters, except for a few days at the annual meeting, when suitable halls can be obtained at slight expense. In this I am endorsed by the Board of Direction in their latest circular,

who say, "The business offices, library and reading room will be ample for a considerably increased membership, excepting only on the occasion of the annual meeting."

Their suggestion as to the expansion of the society's office accommodations whenever necessary are eminently practicable and feasible: to add a sufficient number of stories to furnish such accommodation. The records of the society show that the present four-story building on 57th St., erected on a lot 50 ft. front by 110 ft., average depth, cost in round numbers $[illegible],000. The lot cost $80,000, or $192,000 all told. Adding to the building four additional stories should not cost on a rough estimate exceeding $80,000. To meet this expense, should no better plan present itself, would require that the annual assessment on each member should be doubled for one or two years. As is understood from the secretary's report, the annual income from assessment of members is between $40,000 and $50,000. By the time this expansion of office accommodation is required and before this proposed copartnership building could be gotten ready for occupancy, three or four years hence, this income will have increased by the natural and usual expansion of the society to about $55,000.

With our present headquarters expanded as above outlined, they would occupy a lot of 50 ft. front by 110 ft. depth and could furnish all the accommodation that could be given on our share of the lot of 125 ft. front by 98 ft. depth, on which it is proposed to erect the copartnership building. The auditorium on one of the upper floors could be of the full dimensions of the lot, with ample room for luncheons and a cloak room of ample accommodations for a peg and check for the belongings of every member who would attend the annual and other meetings of the society. An elevator would be required for the expanded building, but with the library and business offices on the lower floors, the expense of operating it need not be incurred, except on "state" occasions such as annual meetings.

In conclusion, I do not think there is the slightest obligation on the part of the American Society of Civil Engineers to join in this copartnership building, as has been intimated, unless they so elect. We have already a headquarter building in a very desirable locality, ample for a much larger membership except on the occasion of the annual meeting. We have assets of the value of $350,000, with a membership and prestige as a society scarcely secondary to that of any similar society of the world. We have attained this position through a hard struggle during the past 50 years. Let us decide this question as our own interests and our own regard for a noble profession shall dictate.

I feel satisfied that our continued prosperity and the present and future prestige of our society require that we should preserve strictly our autonomy and keep aloof from what may hereafter be entangling alliances.

William D. Pickett.

Four Bear, Wyoming, Feb. 7, 1904.

Does the American Society of Civil Engineers wish to Maintain Relations with Other Societies?

Sir: Please allow me to lay before the Corporate Members of the American Society of Civil Engineers a few things which seem to me interesting as I come across them in studying the question *whether we wish to keep up relations with other Societies.*

KEEPING APART.

Our position with regard to architects is instructive. Our society was originally (1852-1868) "the American Society of Civil Engineers *and Architects*," though on March 4, 1868, by a vote of 17 to 4, the name was changed to "the American Society of Civil Engineers." In order to become a corporate member under our present constitution "An Associate Member shall be a professional Engineer or *Architect*" with a certain amount of experience.

After making due allowance for exceptions, it is fair to say generally that architects do not join our Society but belong to other Societies of their own; that we are reconciled to this separation; that the absence of the names of distinguished architects from our list of past presidents or honorary members does not excite remark; that if the architects' societies were looking for friends outside, they might turn toward artists or technical or other societies as well as toward us; and that when the splendor of architecture compels public admiration, we cannot claim credit for it.

It does not appear that the change of name above mentioned was the cause of these facts; more probably it was a consequence. It does not appear that the qualifications required for admission to our Society or to the Societies of Architects, had any important bearing upon these facts. There would be two separate professions even if the requirements for admission to societies had not been what they have been.

If it be desired that a separation of different branches of engineering take place, similar to our separation from architects, a tendency to promote it would seem to be found in letting each engineering society have a house of its own, rather than in housing them together. They could then stand before the public each one for itself and one like another, very much as the names stand side by side in the language of our Constitution, "A Member shall be a Civil, Military, Naval, Mining, Mechanical, Electrical or other professional Engineer, an Architect or a Marine Architect."

The question of separation was ably put by Mr. H. S. Haines in his discussion at the Asheville Convention, from which I extract the following:

> Is it possible that by a process of exclusion we may drive from our membership the mechanical, electrical and mining engineers, and by a further process be deprived of the sanitary engineers, for instance, and the engineers who are contracting for all the municipal and structural works, commercial engineers, if you please? What sort of a residuum would be left to us then? Is the tendency of modern engineering activity to strip our noble tree of one branch after another until nothing is left it but a lifeless trunk?
>
> It is not for the older members of the Society to decide this question; they have no interest in it. The Society will last their time in all its strength and prosperity. It is for the younger members to ponder over. It is a problem which affects their future. I hope that they may solve it as wisely as their predecessors have solved those which have come before them.

Observations similar in spirit though differently expressed have been submitted by other gentlemen (for example, on pp. 252 and 270 of *Proceedings*, Vol. 29, for August, 1903.)

SIDE ISSUES.

The question whether we wish to keep up relations with special branches of engineering may be considered irrespectively of whether the right names or wrong names are applied to Societies, to professional specialties or to practitioners, interesting though the naming may be. Some suggestions about it may be derived from the annual address of the late William E. Worthen as President of our Society at the Kaaterskill Convention in 1887, or from the seven sections of the Engineering Conference in 1897 and 1899 of the British Institution of Civil Engineers.

The question of relations may be considered irrespectively of the qualifications required for admission to societies. We might wish to be separate from some society with a high standard as we are separate from the Institute of Architects; and we might conceivably wish to enter into relations with a society having a low standard of admission. In illustration of this latter supposition may be cited the extensive correspondence with other organizations of civil engineers carried on by our committee on Revision of Constitution and By-Laws in 1889-90 when the subject of affiliation with existing local societies was under consideration, as reported in *Proceedings*, Vol. 16, pp. 139-157.

There is an interest of its own in the matter of qualifications for admission to our Society, which are (in brief) age of 25 years, active practice of six years and responsible charge as principal or assistant for one year. These are required of Associate Members, who are entitled to vote the same as any other Corporate Members, and may before many years possess the numerical control of the Society. In a dozen years their numbers increased by 760 while the number of full members increased by 549. This may be put with Mr. Haines' remark that the future of our Society belongs to the younger men.

If it be desired that eminent specialists should be members of our Society or else become the subject of inquiry why they don't belong to it; if it be desired that the most distinguished ones should be found among our honorary members and upon our list of presidents; and especially if it be desired that whenever the achievements of any of them astound the general public we should be able to say, "Those fellows are nothing but an offshot of ours, we are the real thing;" then a tendency to promote success would seem to be found in our keeping the other Societies under our wing rather than in our pushing them out of the nest.

BEING NEIGHBORS.

It must be generally recognized that it is our own members who in part constitute the societies of the different branches of engineering and that those societies are our professional brethren, perhaps brothers who differ from us in age and not twin brothers. A moderate regard for the fraternal relation would require us to keep on friendly terms with the other societies and be good neighbors when we have an especially favorable opportunity to come in touch with one another.

It is to be hoped that the men who are going to control our Society in the future will appreciate this. They may find some good examples set by the men who controlled it in the past and about whom we have had so much singing of "auld lang syne." The following is an extract from the report of the Board of Direction, Nov. 4, 1876, at the close of the Centennial Exposition:

> In this connection, the Board refers with particular gratification to the most useful, harmonious and agreeable co-operation of our Centennial Commission, with that of the similar Commission of the American Institute of Mining Engineers, whose rooms in the city of Philadelphia, with their large collections of maps and periodicals, have been open to all engineers, and in whose weekly *conversaziones*, our members have been invited to take as conspicuous a part as their own. The joint action of these two Commissions has been of greater service to foreign guests and to the members of the respective societies than their independent action could have been, and it has during the meetings, receptions and excursions of the two societies in June last and on numerous occasions throughout the period of the exhibition, promoted a very large acquaintance and a most kindly feeling among their respective members. It is reasonable and gratifying to believe that the value of this co-operation will not terminate with the Centennial year, but that its results, while in no way interfering with the independence of either Society, will continue to be a permanent benefit to both and to the profession at large.

A joint meeting on Technical Education was held June, 1876, at Philadelphia. In February, 1877, also, a meeting of the American Institute of Mining Engineers was held at the rooms of the American Society of Civil Engineers in New York, and a joint discussion took place there in the evening. On Feb. 20, 1889, a joint meeting of the Society and the American Institute of Mining Engineers was held, at which occurred a discussion on Iron and Steel.

At this time there was also an exchange of courtesies with the American Institute of Electrical Engineers. At the annual meeting of the American Society of Civil Engineers, Jan. 15, 1890, the Secretary of the Am. Soc. C. E. said "the American Institute of Electrical Engineers has for some time been meeting in our rooms. We have been very happy to aid that Institute by offering them the courtesies of our house."

The Secretary of the American Institute of Electrical Engineers addressed the meeting, presenting a set of massive wrought-iron grate fixtures, and said, among other things:

> "Your Society and your officers have afforded us every facility, have given us words of encouragement from that day to the present time, and, from surface indications, it appears that the same cordial feeling will continue to exist hereafter. . . . . .
>
> It gives me pleasure to present to you these fixtures, with the hope that the warmth that permeates through them may represent the feeling that has grown up between us as fellow engineers. (See *Proceedings* Am. Soc. C. E., Vol. 2, pp. 4, 19, 69, 147, 149-50; Vol. 3, pp. 8, 18, 26; Vol. 15, pp. 38; Vol. 16, pp. 14-5, 44.)

The admirable judicial quality and business-like character of the reports which our Board of Direction has submitted from time to time upon the development of the project for a Union Engineering Building suffice to establish its ability fully to safeguard the interests of our Society according to the proviso of the second resolution adopted at the Annual Meeting.

Yours respectfully

Fred. Brooks, M. Am. Soc. C. E.

31 Milk St., Boston, Feb. 11, 1904.

ANNUAL MEETING OF THE AMERICAN INSTITUTE OF MINING ENGINEERS AT ATLANTIC CITY.

The 86th meeting of the American Institute of Mining Engineers was to have been held in Baltimore, Feb. 16 to 20, but the disastrous fire in that city necessitated a change of plans at the last moment. The Council, therefore, issued circulars announcing that Atlantic City had been selected as the place of meeting. In consequence of this change the number of members in attendance was somewhat less than is usual at the annual meetings; and no time was left for the arrangement of excursions and entertainments.

At the opening session, at 8 p. m., Feb. 16, Mr. Albert R. Ledoux delivered his presidential address, "The American Engineer of To-day." He believes that the supremacy of the American engineer, particularly in mining, is due not so much to education as to environment. Nevertheless, he made it clear that environment has had its effect upon educational methods, so that the American student is less fettered by tradition. The inventive faculty is not only an American attribute, but is greatly stimulated by the absence of settled custom and practice in doing things. The mining man and the smelting man in America has been encouraged by the capitalist in the effort to develop new machinery and new processes. Moreover engineers themselves have a spirit of fraternity not always seen abroad. They do not hesitate to make public the means by which they have reduced the cost of production, and it is to be hoped that no change in industrial management will result in stopping this free interchange of ideas. Such in essence was President Ledoux's address, enlivened by many pointed anecdotes and delivered in the easy and pleasing manner of which he is a master.

The regular papers announced by title were 39 in number, the greater number of which were in print, although several are still in manuscript.

The second session, Feb. 17, was devoted to papers on iron and steel, of which there were an unusually large number of great interest and value. Perhaps the most striking of these was a paper by Mr. Alexander E. Outerbridge, Jr., "The Mobility of Molecules of Cast Iron." The title is somewhat of a misnomer, since it conceals the particular discovery brought out in the paper, namely, that cast iron can be made to swell at least

40% in volume by successive heatings and coolings. By heating a cast-iron bar, 1 × 1 × 14 ins., for an hour at 1,450°, and then cooling, its length was permanently increased ⅛-in. By repeating this process 27 times the bar was made to grow in length 1 11-16 ins., and in cross-section ⅛-in. in each direction. The bar neither lost nor gained in weight, so that its specific gravity was greatly reduced, and at the same time it lost somewhat in tensile strength. Nevertheless, so far as the eye could discern, the sample of "swelled" iron

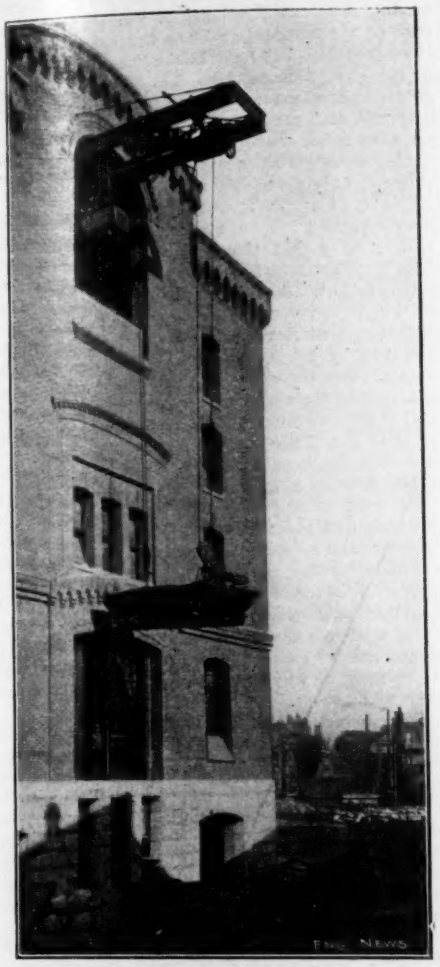


Fig. 1. Coal Hoisting Plant for the Milwaukee Electric Railway & Light Co., Milwaukee, Wis. Pawling & Harnischfeger, Milwaukee, Wis., Builders.

looked exactly like ordinary cast iron. This swelling by successive heatings and coolings explains the warping of cast-iron grate bars, and certain other phenomena that have been noted in the past.

PAPERS ANNOUNCED.—So many papers were presented that even the briefest mention of each would occupy a great deal of space; therefore, a mere enumeration of the papers and their authors will be given:

1. Note on the Further Discussion of the Physics of Cast-Iron, by William R. Webster, Philadelphia, Pa.
2. Note on the Physics of Cast-Iron, by Richard Moldenke, New York City.
3. The Mobility of the Molecules of Cast-Iron, by Alexander E. Outerbridge, Jr., Philadelphia, Pa.
4. Chemical Specifications for Pig-Iron, by Edgar S. Cook, Pottstown, Pa.
5. Specifications for Pig-Iron and Iron Castings, by Robert Job, Reading, Pa.
6. Standardization of the Specifications for Cast-Iron and Steel, by William R. Webster and Edgar Marburg, Philadelphia, Pa.
7. Specifications for Testing Cast-Iron, by Henry Souther, Hartford, Conn.
8. Present Specifications for Cast-Iron, by C. R. Baird, Philadelphia, Pa.
9. Specifications for Cast-Iron and Finished Castings, by R. Moldenke, New York City.
10. Specifications for Car Wheels, by Dr. Charles B. Dudley, Altoona, Pa.
11. Specifications for Malleable Cast-Iron, by Stanley G. Flagg, Jr., Philadelphia, Pa.
12. Specifications for Steel Rails, by Robert W. Hunt, Chicago, Ill.
13. Specifications for Iron Pipe, by Walter Wood, Philadelphia, Pa.
14. A Decade in American Blast-Furnace Practice, by F. L. Grammer, Baltimore, Md.
15. Direct Metal and Cupola Metal Iron Castings, by Thomas D. West, Sharpsville, Pa.
16. Stock-Distribution and Its Relation to the Life of a Blast-Furnace Lining, by David Baker, Cape Breton, Canada.
17. Bituminous Coal Breaker, by Lewis Stockett, Stockett, Mont.
18. Fuel and Mineral Briquetting, and the Peat Industry, by Robert Schorr, San Francisco, Cal.
19. Mineral Deposits of Santiago de Cuba, Cuba, by Harrison Souder, Philadelphia, Pa.
20. Notes on the Gold District of Canutillo, Chile, by S. H. Loram, Canutillo, Chile, S. A.
21. Concrete in Mining and Metallurgical Engineering, by Henry W. Edwards, Grand Junction, Colo.
22. Wet Methods of Extracting Copper as Adopted at Rio Tinto, by Charles H. Jones, Santiago de Cuba, Cuba.
23. Testing Gold Ores by Amalgamation, by Ernest A. Hersam, Berkeley, Cal.
24. Note on the Relation Between Arsenic and Electro-Motive Force in Copper Electrolysis, by L. Webster Wickes, Anaconda, Mont.
25. Preliminary Tests and Cyanide Treatment of Silver Ores in Mexico by the MacArthur-Forrest Process, by John F. Allan, Mexico City, Mexico.
26. Radium and Radio-Active Minerals and the Search for Them, by George F. Kunz, New York City.
27. Biographical Notice of Prof. Robert H. Thurston, by R. W. Raymond, New York City.
28. Pyritic Smelting at the National Smelter of the Horseshoe Mining Co., Rapid City, by Charles H. Fulton and Theodore Knutzen, Rapid City, S. Dak.
29. Plotting Sizing Tests, by W. S. Hutchinson and R. H. Richards, Boston, Mass.
30. Notes Upon Thornton's and the Grubb-Davis Mine-Surveying Dials, etc., by H. D. Hoskold, Buenos Ayres, S. A.
31. Note on the Cost and Speed of Sinking the East Shaft of the New Klienfontein Co., Benoni, South Africa, by Edward J. Way, Benoni, Transvaal, S. Africa.
32. The Payne Magnetic Separator, by C. Q. Payne, New York City.
33. Estimated Cost of Mining and Coking and Relative Commercial Returns from Operating in the Connellsville and Walston-Reynoldsville Districts, Pennsylvania, by Edward V. d'Invilliers, Philadelphia, Pa.

The six remaining papers were printed discussions of papers read at previous meetings.

NEW OFFICERS.—The officers elected for the ensuing year are: President, James Gayley; Secretary, R. W. Raymond, and Treasurer, Frank Lyman.

EXCURSIONS.—As above stated, the change in meeting place made it impossible to arrange for many excursions; but on the afternoon of the third day the sand-lime brick works of the H. Huennekes Co. system were visited as well as the section of surface contact electric railway now operating under the patents of Leon W. Pullen.

A number of the members of the Institute purpose making a pleasure trip through the West Indies, starting March 8 on the steamer "Princessin Victoria Louise."

A NOVEL COAL HANDLING PLANT.

The new Commerce St. power house of the Milwaukee Electric Railway & Light Co., of Milwaukee, Wis., is so located that coal has to be delivered to it by wagon, and as the coal is stored in bins at the top of the building, a special method was devised to economically and rapidly handle the coal from the street to the storage bins, a height of about 40 ft. The electric railway company has its own wagons, and these are made with removable bodies, which are hoisted to the top floor by an electric traveling hoist which then conveys it back to the point where it is to be dumped. Fig. 1 shows a wagon load of coal being hoisted, and Fig. 2 shows the traveling hoist.

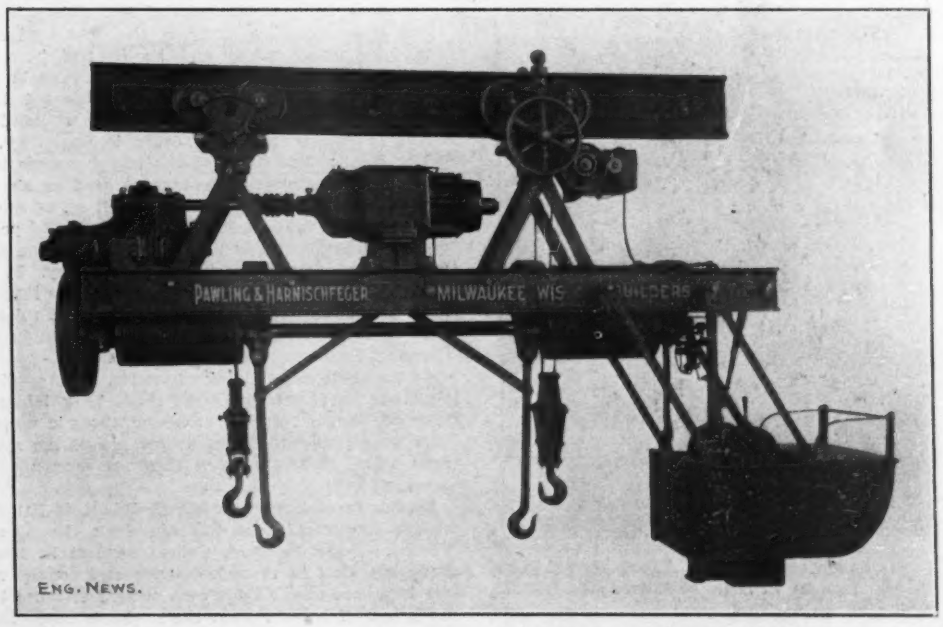


FIG. 2. ELECTRIC TRAVELING HOIST FOR COAL HANDLING PLANT.

The hoist runs on a 20-in. I-beam runway, which extends 20 ft. beyond the building, and the projecting part of the runway is composed of two members, suitably braced and tied. The length of the single I-beam runway within the power house is 80 ft. and covers the several storage bins. From the double trucks running on the lower flanges of the beam the hoist is suspended by means of two rigid A-frames attached to the channels of the hoist frame.

The travel movement is effected by a 3-HP. motor geared to the driving trucks. The maximum travel speed is from 150 to 175 ft. per min. The hoisting capacity is 5 tons, effected by a 25-HP. motor placed on top of the channel hoist frame. This, through reduction gearing, operates the shaft, which is equipped with double drums. Within this hoist gear train is placed a load brake to sustain the load at any point, should the current be shut off. The two single grooved drums carry a four-part 9-16-in. crucible steel wire rope of a length to afford a hoisting distance of 60 ft. The maximum rate of hoisting per min. is 50 ft. under full load and 125 ft. light.

As already noted, the coal is delivered to the power house in special wagon boxes, each box having a capacity of 8,000 lbs. The wagons are driven beneath the hoist and the operator lowers the bottom blocks for the driver to hook into the bails with which the body is previded. There are two sets of bails, one set being attached by chains to drop bottoms and the other set being fastened to the sides of the box. The hooks having been attached to the first set, serve to retain the coal in the wagon box and permit its being elevated to the hoist doorway, and thence the hoist carries it to the proper coal bin.

The coal is dumped by the operator throwing a lever that causes two auxiliary hooks, shown in Fig. 2, to engage with the second set of bails. When so engaged, by a slight lowering of the load the weight of the coal opens the drop bottoms and the coal falls into the bin selected. After this dumping, the operator raises the box, places the strain on the first set of bails, and then disengages the hooks. The hoist then carries the empty box to the outer framework and lowers it onto the wagon running gear.

The weight of the hoist without load is 10,000 lbs. The length over all is 16 ft. 10 ins., with a height over all of 11 ft. 1 in. A direct current of 220 volts is used. The hoist takes its power through two main line conductors placed one on each side of the I-beam. All operations are effected from a cage which holds the operator's seat, the switchboard, two reversible controllers and other needed mechanism. This interesting

machine was built by Pawling & Harnischfeger, of Milwaukee, Wis., and we are indebted to the builders for photographs and information concerning it.

AN 80-FT. STAND-PIPE OF REINFORCED CONCRETE AT MILFORD, OHIO.

The use of reinforced concrete in tank and bin construction has been extensive in both Europe and America. In most instances, however, these tanks and bins have been rather shallow in comparison with their lateral dimensions, which is a form directly opposite to that of the ordinary water-works stand-pipe. In this respect of considerable height and moderate diameter, therefore, the concrete-steel stand-pipe shown by the accompanying illustration is sufficiently different from previous tank construction to warrant its description.

The stand-pipe illustrated by Fig. 1 was erected recently at Milford, Ohio. It is 81 ft. high from base to roof, and the roof has a rise of 3 ft., making the total height of the structure 84 ft. The outside diameter is 15½ ft. The shell at the base is 9 ins. thick and maintains that thickness for 30 ft., when it is reduced to 7 ins., and again at the height of 55 ft. to 5 ins. The reduction in thickness is made wholly on the inside of the pipe. The structure has an inside and an outside ladder and gives 78 ft. of net water space.

The foundation is octagonal with an inscribed diameter of 20 ft., and is 6 ft. deep. It was constructed of concrete composed of 1 part cement and 7 parts clean river gravel containing about 40% sand and pebbles up to 4 ins. in diameter. On the top of this concrete slab 1 × 1 × ⅛-in. T-bars were laid radiating from the center to within 6

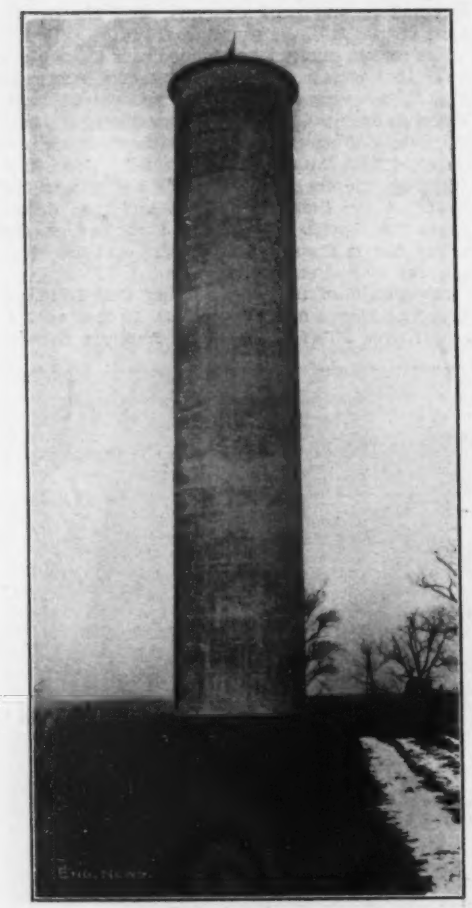


Fig. 1. Reinforced Concrete Water-Works Stand-pipe 81 ft. High, at Milford, O.

ins. of the outer edge. The shell was started directly on these T-bars and after being carried up a sufficient distance the base outside the shell was covered with concrete 16 ins. deep and the base inside the shell was covered with a 6-in. layer of 1 cement and 3 sand mortar. The shell is built of this same mortar and is reinforced by a network composed of verticals spaced 18 ins. apart around the structure, and of horizontal rings spaced six to the foot for 30 ft., then five to the foot for 25 ft., and then four to the foot for the remainder of the height. These verticals and rings are 1 × 1 × ⅛-in. T-bars connected at intersections by clamps of the forms shown by Fig. 2. The position of the reinforcement was 3 ins. inside the outside face of the shell.

The forms used in constructing the stand-pipe consisted of 3 × 1½-in. staves nailed to circular ribs of 4 × 4-in. timber. The topmost rib extended 1 in. about the tops of the staves so as to form a rabbit to receive the bottom of the next form.

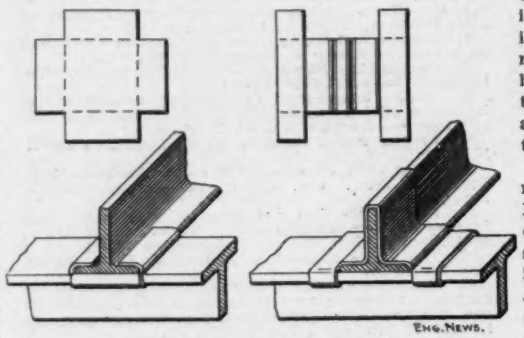


Fig. 2. Clips for Connecting T-bar Reinforcement of Milford, Ohio, Stand-Pipe.

Three sets of forms were used, each 3 ft. high. Each set consisted of an inner and outer form, each divided into eight segments for convenience in handling.

The stand-pipe was built by Mr. J. L. H. Barr, of Batavia, Ohio, who sends us the following item respecting its cost:

> I cannot give exact figures of the cost, but will say that we used about 25,000 lbs. steel, 270 bbls. cement, 68 cu. yds. of gravel and about 90 cu. yds. of sand, and the total cost, including royalty paid to the Steel Concrete Co. of Chicago, was less than the lowest bid for a steel tank of like dimensions by over $200. Moreover, the Milford people think they have the best stand-pipe made.

THE METRIC SYSTEM BEFORE CONGRESS.

From an argument presented by Mr. F. A. Halsey, M. Am. Soc. M. E., before the House Committee on Coinage, Weights and Measures, opposing the bill for the compulsory use of the metric system by the United States in Government transactions, the following abstract is made.

Mr. S. S. Dale, of Boston, and Mr. Halsey have spent some years in studying the extent of the use of the metric system and the effect of the concurrent use of two systems, which prevails in all metric countries, and which the proposed bill would introduce here. This is a line of inquiry never previously taken by other investigators.

The House Committee of the last Congress reported that the metric system was used by about two-thirds of the people of the world; or, as some writers on the subject state it, by 480,000,000 people. This statement is declared to be absolutely without foundation of fact by Mr. Halsey. It is true that various nations have passed laws favorable to the metric system, but it does not follow that these laws have effected the introduction of the metric system into universal use.

Of the countries claimed as metric, we may distinguish three classes: First, those in which the laws are simply permissive; second, those in which they provide for the government use of the system; third, those in which they are compulsory upon the public.

Japan, for example, is included in this list of metric countries. But the American Consul at Tokio and the Japanese Consul-General in New York say that in their industries and commerce the Japanese prefer their own system and use it. By a law of March, 1891, the shaku is made the unit of measure, and the kwan the unit of weight; and the same law fixes the ratio of the shaku and kwan to the metric system and legalizes the use of the metric system. Turkey and China are both claimed to be metric countries, but Turkey has been compelled to repeal the law making the use of the metric system compulsory; and the Chinese tariff schedule is based on Chinese standards of weights and measurements; and the people use both Chinese and European standards.

For government purposes only, the system was adopted by Greece in 1836, but the people do not use it. The system was introduced into Egypt for the same purpose and with the same result. It was also tried in many Spanish-American countries and in Cuba; again with like results. In these countries the metric system may be established as a standard for the payment of custom duties and for official purposes, but the people in trade use old Spanish and English measures, often mixing different standards of weights and measures in one transaction. The Spanish government is supposed to have established the metric system in the Philippine Islands. Mr. Halsey shows that nearly every business house, manufacturing establishment and government institution in that country uses scales with pounds on one side of the balancing arm and kilos on the other, because "sometimes the metric system is required."

In regard to the countries where the use of the metric system is compulsory upon the people, Mr. Halsey says that the conditions there found are due to the operation of a simple principle that seems to have hitherto escaped observation. That is, that in any country in which the individual has any rights whatever, compulsory laws do not and can not be made to apply to factory measurements. The testimony regarding the wide use of the metric system relates exclusively to commercial measurements, and Mr. Halsey believes that he and Mr. Dale were the first to discuss this question from the factory point of view.

The law may and does prescribe—in countries having no constitutional limitations—the units of weights and measures to be used in commercial transactions between individuals. But goods made in factories for the open market are commonly made in advance of such transactions. While making, such goods are absolutely the makers' own, and while the price units by which such goods are sold must be metric, the actual dimensions may be anything whatever that the customer will accept.

The operation of this principle is shown in Mexico, where lumber is sawed to feet and inches, while the Mexican bill for lumber calls for so many square meters of one-inch boards. A Mexican bill for bar-iron will call for so many kilograms of one-inch iron. The same, and even more mixed conditions prevail in the Mexican method of finding the assay value of ores of gold, silver and lead; in these assays metric, English and Mexican units are used. The German Society of Civil Engineers last July adopted a standard for pipe and pipe threads, and in the table submitted the bore and the pitch of the thread is given only in English inches. In other words, the German engineers have adopted the Whitworth pipe standard, and they acknowledge that for this purpose the inch unit is better than the metric for factory use. While the use of the metric system has been compulsory in Germany for thirty years, German house builders still employ the Rhenish inch in handling their brick, lumber and timbers.

France is the home of the metric system, yet the application of the system in the French textile industry is "a roaring farce," says Mr. Halsey. While silk fabrics are sold across the counters of Paris by the meter, they are still made in the mills of Lyons by the aune, the denier and the French inch. In this same textile industry in Germany the raw material is purchased by the English pound and sold by the meter; the "yarn counts" are English, the length and width of the finished goods are metric; and while the weight of the yarn is calculated in grams, the total length of the yarn in meters is reduced to English yards and then to English skeins of 560 yds. each. Mr. Halsey presents other illustrations of a similar nature.

The reasons for the persistent existence of these old units are either: That the change is so difficult to make that it can not be made; or, that the manufacturer prefers the old units. As a fact, says Mr. Halsey, the change from old to new units is very difficult for the manufacturer, notwithstanding the assertion to the contrary made by the scientific user of standards. The industrial use of measurements is to make things of a cer-

tain size; the scientific use of measurement consists in measuring thing already made. From the measurer's standpoint a change in standards simply involves a change in measuring instruments; while from the maker's standpoint this change involves a change in the sizes of the things made and al. which that includes.

Mr Halsey comments on the reported approval of the metric system by eleven different societies, ten of these national in their scope, as published in the report of the House Committee two years ago. He submits letters from the secretaries of these societies answering queries on this head, which show that the following seven of these societies have never taken any action as a society upon the metric system: The Association of American Steel Manufacturers, the New England Cotton Manufacturers' Association, the American Society of Civil Engineers, the American Institute of Architects, the National Association of Builders, the American Institute of Electrical Engineers,* and the Civil Engineers Club of Cleveland. Yet all of these societies were put down in the list as approving the adoption of the metric system.

BRIDGE SPANS CARRIED AWAY BY MOVING ICE.

It is not an uncommon thing in northern rivers of rapid current for an ice jam to raise the water far above the ordinary flood heights. Bridges are apt to be thus lifted off their piers and swept down stream when the gorge breaks.

The usual thing in such disasters is for the bridge to be wrecked at once; but we show in the accompanying photographs some bridge spans which were carried off in an ice jam and suffered so little injury that they are now being taken apart for re-erection. The photograph is sent us by Mr. R. D. Chidsey, Jr., of Sunbury, Pa., who also contributes the following particulars of the accident:

Sir: The bridge shown in the photograph was being erected by the King Bridge Co., of Cleveland, O., at Cressy, or Mifflinville, Columbia Co., Pa. It was to be a six-span structure, each span being 213 ft. 6 ins. c. to c. of end pins. At the time the gorge occurred three spans had been erected. The falsework and the floor system of the fourth span had been carried away by high water some time previous to the taking out of the three spans shown in the photographs. These spans were taken out on Feb. 9, 1904, when the ice suddenly jammed, lifting the iron work off the piers and carrying it down stream. The spans were taken out at different times, the center span or the one in the distance going first, the others following in order. The center span was carried about 1,500 ft. down stream.

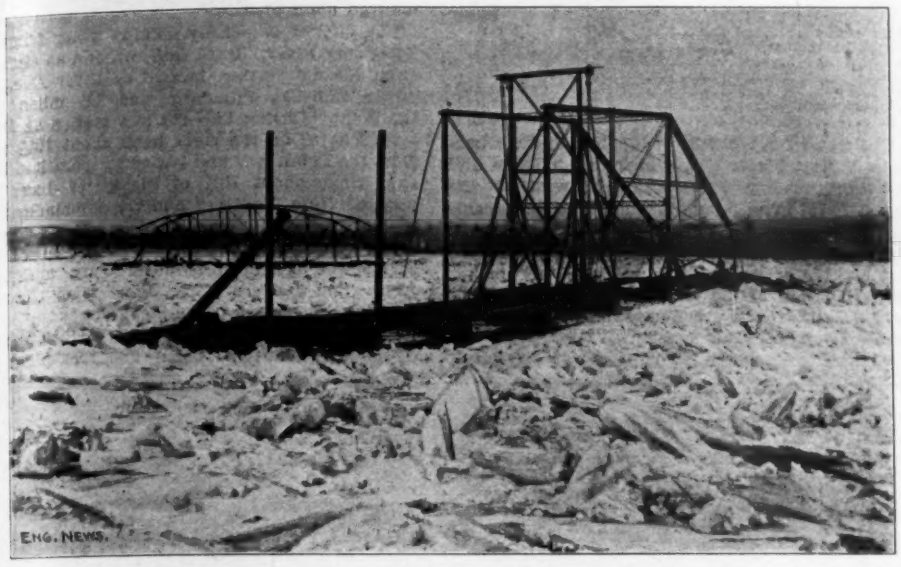
The spans are still standing, and seem to have been very little damaged. The work of taking them down has been started. The shore span, or the one in the foreground, has been nearly taken apart, as is shown in the photograph.

Later information is to the effect that all the piers have been destroyed.

*The Board of Directors of the American Institute of Electrical Engineers did adopt resolutions favoring the system, but the Institute as a body never took action upon it.

TYPHOID FEVER HISTORY AND THE WATER SUPPLY OF PITTSBURG, ALLEGHENY AND VICINITY.*

Much interest has been aroused by the spectacular epidemic of typhoid fever which recently held sway at Butler, Pa. So sudden and so marked was this outbreak that, attention being diverted for the time being, sight is lost of the fact that all over the western part of Pennsylvania typhoid



THE WORK OF AN ICE GORGE IN THE NORTH BRANCH OF THE SUSQUEHANNA RIVER.

fever is endemic and in many places exists to a degree certainly noticeable. The condition, if not alarming, is only so because the people have been accustomed to it.

GENERAL.

Large cities are the collectors of many cases of contagious and infectious diseases, because people from the surrounding country and smaller places, with lack of good facilities for treatment and care of such sick persons, are sent to the hospitals of the cities, where it is known the best services will be obtained. That this is an important factor, it is only necessary to state that the hospital deaths from typhoid fever in Pittsburg, for people coming from outside the city limits, averages about 25% per year of the whole number occurring from typhoid fever in the entire city.

That large cities are also the great distributers of infectious diseases like typhoid fever must be apparent, if we will stop to think that the visitor to the city, coming from a place where uncontaminated drinking water is obtained, drinks freely of the unpurified river water of such places and easily succumbs to the attack, he being not accustomed to the beverage; in other words, not being immune.

It was pointed out in the article upon the typhoid fever epidemic at Butler, Pa. (see Engineering News, Dec. 24, 1903), that typhoid fever had existed for some years upon the drainage area above the sources of water supply. This is a fair example of the conditions in any country and village territory within easy traveling distance of large centers of population, having a polluted water supply.

Before entering into a description of the various and somewhat diverse sources of water supply of Pittsburg, Allegheny and Wilkinsburg, and before taking up the detailed figures of typhoid fever in the cities named, let us glance at Table A, in order to get a general idea of the gravity of the typhoid situation in Pittsburg and Allegheny. This table shows the yearly number of cases and deaths, both in totals and for each 10,000 population, and also the percentage of deaths to cases for the years 1890 to 1903, except that for Allegheny the 1903 figures are missing. In the period named Pittsburg had reported 30,275 cases, not including hospital cases charged to "outside of city," in 1890 and 1891, and 4,214 deaths from typhoid, while Allegheny, for the 13 years covered, had reported 10,869 cases and 1,651 deaths. Adding in an approximate estimate for Allegheny for 1903 there have been about 6,000 deaths from typhoid in the two cities during the past 14 years. In 1903 alone there were 3,662 cases and 474 deaths in Pittsburg, or 102 cases and 13.2 deaths per 10,000 of estimated population.

Figures for a number of years past for other large cities, some of which were cited in Engineering News for Dec. 31, 1903, show that Pittsburg and Allegheny virtually head the list of cities having an excessive amount of endemic typhoid. Table II carries back the total yearly deaths from typhoid at Pittsburg to the year 1873, and shows that for 31 years the disease has existed there unchecked.

In what follows an attempt will be made to present (1) some of the local conditions affecting typhoid fever in the municipalities named, and (2) the typhoid statistics for those municipalities in as much detail as the local records of vital statistics and our space will permit. It is only fair to say that lack of space compels us to omit a large number of additional interesting figures, which have been supplied to us, showing by wards the total number of cases and deaths and also the cases per 10,000 population, for the same period as is covered by our Table A. We are quite confident, however, that seldom have there been presented more detailed typhoid figures for so long periods as will be found in our Tables II., III., and V., to which reference will be made after the sources of water supply have been discussed.

WATER SUPPLY SYSTEMS.

The water supply for the first 23 wards of Pittsburg (see the ward map, Fig. 1) is obtained from the Allegheny River, at a pumping plant at Brilliant Station, situated six miles above the Point at the beginning of the Ohio River. The water is pumped directly from the river without any means for purification, to two reservoirs located in Highland Park. These have a capacity of 242,000,000 gallons. The average daily pumpage is about 70,000,000 gallons, or 253 gallons per person per day. Water for Wards 1 to 23, inclusive, is obtained from these two reservoirs, but several districts of the city have water from greater elevations, of which there are four. Water is pumped to these high service reservoirs at

TABLE A.—Cases and Deaths of Typhoid Reported at Pittsburg and Allegheny, Pa., 1890 to 1903, Inclusive.

	Pittsburg					Allegheny.				
	Cases		Deaths		P. ct.	Cases		Deaths		P. ct.
Year.	Total.	Per 10,000.	Total.	Per 10,000.	deaths to cases.	Total.	Per 10,000.	Total.	Per 10,000.	deaths to cases.
1890	1,561*	65	315	13.2	20.2	481	46	146	13.9	30.4
1891	1,149*	47	249	10.1	21.7	410	46	96	10.7	23.4
1892	1,373	49	256	10.1	20.6	918	71	171	13.3	18.7
1893	2,398	83	292	11.3	13.6	1,476	131	161	14.3	10.9
1894	1,231	55	152	5.7	13.3	755	65	99	8.6	13 1
1895	1,737	58	213	7.7	13.4	1,735	147	227	19.3	13.1
1896	1,349	48	175	6.2	13.0	409	34	59	4.9	14.4
1897	1,408	48	184	6.3	13.1	597	49	79	6.5	13.2
1898	1,916	63	218	7.2	11.4	518	42	73	5.8	14.1
1899	2,373	76	342	11.0	14.4	895	70	135	10.6	15.1
1900	3,342	104	464	14.4	13.9	879	68	121	9.3	13.8
1901	3,412	102	416	12.4	12.2	915	70	135	10.2	14.7
1902	3,364	97	463	13.3	13.8	881	66	149	11.6	16.8
1903	3,662	102	474	13.2	12.9	...	...	...	...	....
Total	30,275*	...	4,213	....	....	10,869	..	1,651	....	....
Average	2,297	73†	301	10.3	14.2	836	67	127	10.0	13.0

For deficiencies in some of the Allegheny figures and for notes on the figures for both cities, see the other tables.
*For city, only; hospital cases from outside of the city for years 1890 and 1891 not available.
†Average for 12 years, only.

*Prepared from data and comments thereon obtained through the courtesy of the various health officials of Pittsburg, Allegheny and Wilkinsburg. Especial credit for compilation and notes is due to Dr. E. G. Matson, Bacteriologist and Registrar of Vital Statistics of the Bureau of Health of Pittsburg, and to Mr. Morris Knowles, M. Am. Soc. C. E., Filtration Engineer of the same city.

three stations, drawing water from the main pipes of the distribution system.

The drainage area of the Allegheny River above Brilliant is about 11,400 square miles and had an urban population in cities and boroughs of 28.2 per square mile in 1900. The total population of such places was 321,877. There were 5 places of above 10,000 people, 7 places had between 5,000 and 10,000, 55 places had between 1,000 and 5,000 and the remainder contained less than 1,000 people each. Several good-sized places are within 50 miles.

The water supply of Wards 24 to 36, called the South Side, is obtained from the Monongahela River, from a pumping station owned by the Monongahela Water Co., located at the foot of 29th St., about three miles above the Point. Water is obtained through an intake pipe from the river without any means of purification and is pumped to a reservoir and two tanks of higher elevation upon the hill top. The use of water per person is about the same as in the old city, corresponding to about 20,000,000 gallons per day.

The drainage area of the Monongahela River above the intake is about 7,600 square miles and had in 1900 an estimated urban population, in cities and boroughs, of about 24 per square mile.

Four places have over 10,000 people, 6 have between 5,000 and 10,000 and 19 have between 1,000 and 5,000.

Several of the larger places are within 13 miles, but the stream does not have as great a velocity as the Allegheny, and on account of the U. S. Government Dams and Locks, built for navigation purposes, it has many pools and thus greater opportunities for sedimentation than the waters of the Allegheny River.

The average composition of the waters of the two streams, as determined from the results of the analyses made by the Pittsburg Filtration Commission, for the year ending July 31, 1898, is shown by Table I.:

TABLE I.—Comparative Average Composition of Water From the Allegheny and Monongahela Rivers. (Chemical results in parts per 1,000,000.)

Determinations.	Rivers— Allegheny.	Monongahela.
Bacteria, per cu. cm.	16,500	19,200
Nitrogen: As ammonia (free)	0.019	0.066
As ammonia (albuminoid)	0.117	0.149
As nitrites	0.000	0.000
As nitrates	0.705	0.880
Total solids	156.0	208.0
Suspended matter	42.0	64.0
Chlorine	21.7	11.8
Hardness	35.5	43.6
Alkalinity	28.7	13.5
Sulphuric acid	14.8	40.0
Iron	0.54	0.97

The water for Ward 38 is supplied by the Chartiers Valley Water Co., which has a large and growing territory south and southwest of the South Side. The pumping station of this company is located at Beck's Run, on the left bank of the Monongahela about four miles above the Point. Water is pumped without any means of purification to the hill top into standpipes of very small capacity, compared to the average daily use of the whole system.

The water supplied to Ward 37, of Pittsburg, formerly called Brushton, and to the adjoining borough of Wilkinsburg, is obtained from the pumping station of the Pennsylvania Water Co., located upon the left bank of the Allegheny River, about 1½ miles above Brilliant Station. The works were built in 1888 and 1889. Water is obtained from two cribs, located under the bed of the stream. One of these two cribs, which are alike, was built in the latter part of 1901. Each crib is composed of timber cribwork, filled and weighted down with large stones; over this is placed coarse gravel, and then this is covered with river sand. The water from this source is generally less turbid and usually contains less bacteria than the river water itself, but at the same time is harder, indicating the inflow of some ground water. Sometimes, however, holes are broken through the filling material, which lets in river water directly to the intake pipes. Water is pumped about one mile to a reservoir just east of Ward 31 of Pittsburg and is thence distributed to Ward 37 and part of Wilkinsburgh. A portion of Wilkinsburgh also obtains water by direct pumping from a large main pipe.

The city of Allegheny obtains water from the Allegheny River. Until 1897, water was obtained from the old station, located at River Ave., opposite 22d St., Pittsburg, and 1¾ miles from the Point. During 1897 the new station at Montrose, located on the right bank about 10½ miles from the Point, was first placed in operation. Since that time, about 75% of the water has been pumped from Montrose and the remainder from the old station.

The station at River Ave. is located below several sewer outlets of both Pittsburg and Allegheny and delivers water direct from the river without any means of purification.

Water at the Montrose pumping station is obtained from a large timber and rock-filled crib

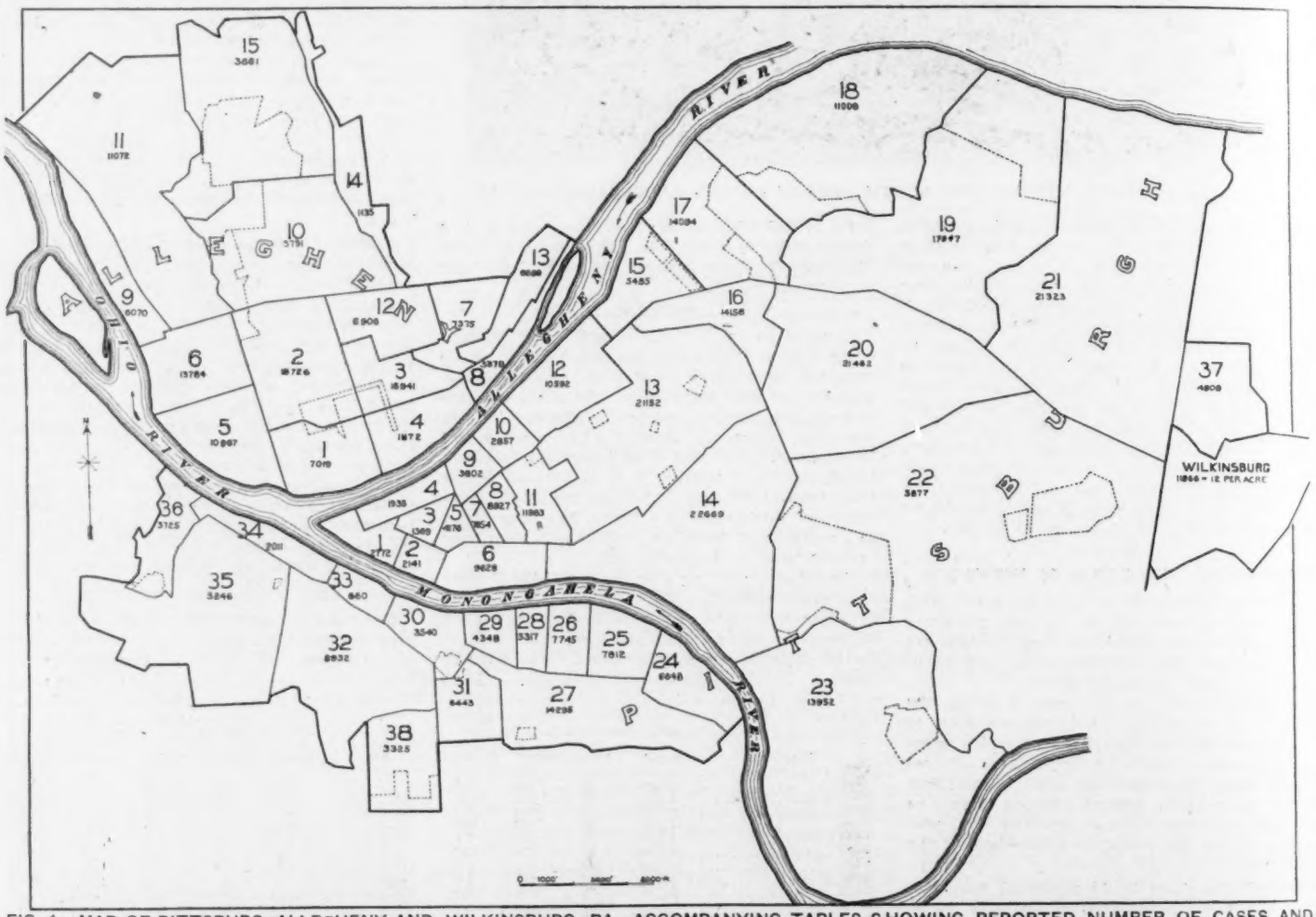


FIG. 1. MAP OF PITTSBURG, ALLEGHENY AND WILKINSBURG, PA., ACCOMPANYING TABLES SHOWING REPORTED NUMBER OF CASES AND DEATHS FROM TYPHOID FEVER PER 10,000 OF POPULATION FOR EACH WARD DURING SIX YEARS, 1898 TO 1903, INCLUSIVE.

The Ward numbers are shown in heavy figures.
The Census populations for 1900 are given under the Ward numbers.
The populations for all years except 1900 are estimated from Census returns for 1890-1900.
Park and Cemetery areas are shown by dotted lines.

in the river. There are said to be holes, however, in the filling material and the water obtained does not differ from that of the river itself. The average daily use of water in Allegheny is about 42,000,000 gallons, corresponding to 310 gallons per person.

There are two high service stations, one obtaining water from Troy Hill reservoir of 7,500,000 gallons capacity and the other out of a main pipe leading from this reservoir.

PITTSBURG TYPHOID STATISTICS.

Mortality statistics in Pittsburg have been kept with intelligent care for many years, and records of the cases of infectious diseases are in better

shape than in most places. Tabulations by wards and by months are made with facility. Fortunately has been 10.0; higher than most years for Hamburg, Germany, before filters were introduced, vacation season are productive of fatalities from this disease. After a rapid rise and climax

TABLE III.—DEATHS FROM TYPHOID FEVER IN PITTSBURG, PA., PER 10,000 OF ESTIMATED POPULATION FOR EACH YEAR, FROM 1890 TO 1903, INCLUSIVE, ARRANGED BY WARDS.

	Population in 1900.	Persons per acre.	Deaths per 10,000 of estimated population. 1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	Average for 14 yrs.
1st Ward	2,772	34.4	5.4	4.8	5.6	2.9	0.0	9.2	0.0	6.5	5.4	7.0	10.8	11.2	7.7	16.0	6.1
2d "	2,141	35.8	2.7	0.0	0.0	21.5	0.0	3.4	3.6	0.0	24.4	0.0	4.7	10.0	10.9	23.6	6.6
3d "	1,369	27.1	4.8	0.0	10.2	0.0	0.0	5.8	0.0	0.0	6.6	0.0	0.0	0.0	32.0	25.0	5.5
4th "	1,935	20.5	0.0	2.5	3.5	10.7	0.0	3.9	0.0	0.0	0.0	4.9	5.2	0.0	5.9	25.0	3.8
5th "	4,176	114.6	3.9	3.4	4.1	10.2	0.0	4.3	6.6	9.0	6.9	7.0	14.4	17.2	7.5	15.0	7.5
6th "	9,628	152.2	1.1	7.4	3.3	20.6	2.2	4.3	3.2	1.1	4.2	6.3	9.3	6.0	13.8	10.6	6.9
7th "	7,654	180.3	6.8	3.1	6.4	3.1	0.0	1.5	5.8	2.9	0.0	1.3	10.5	15.2	12.3	16.7	6.5
8th "	8,927	127.4	8.7	3.8	4.1	2.7	2.6	5.2	5.1	1.3	6.0	2.3	10.1	6.5	6.3	7.1	5.2
9th "	3,802	61.2	2.3	5.6	4.7	2.4	4.9	4.5	7.5	0.0	2.6	7.8	18.4	16.0	24.2	16.2	8.0
10th "	2,857	39.4	13.9	0.0	2.9	8.9	6.1	3.1	3.2	6.5	6.7	3.4	10.5	14.2	10.7	5.3	6.7
11th "	11,883	80.3	10.1	4.6	1.6	8.7	2.9	2.8	2.8	4.4	2.7	6.9	8.4	14.8	11.2	11.7	6.9
12th "	10,592	40.0	7.7	7.5	8.7	15.3	5.8	5.8	1.0	1.0	12.3	16.1	26.4	22.2	20.3	33.7	13.2
13th "	21,152	26.4	3.6	6.7	5.5	8.1	3.9	4.6	3.7	5.3	8.2	5.6	14.2	18.1	9.7	3.7	6.7
14th "	22,669	22.8	12.9	8.0	11.2	5.1	2.2	5.9	3.7	2.0	3.3	5.5	16.3	12.7	9.3	10.2	7.8
15th "	5,485	44.4	13.9	1.8	8.8	8.8	3.6	8.9	7.1	0.0	5.4	9.1	10.9	11.0	11.0	9.3	7.8
16th "	14,156	49.6	25.0	12.6	12.2	8.5	8.2	8.0	3.1	9.1	3.0	8.0	12.0	10.3	9.3	9.7	9.7
17th "	14,094	46.9	13.8	6.4	8.7	50.5	4.6	5.3	2.2	3.7	4.4	10.8	12.8	16.9	15.2	11.5	10.5
18th "	11,008	11.4	10.0	11.0	18.2	12.6	12.1	3.5	4.5	5.4	6.1	16.3	6.3	7.8	14.8	10.2	9.9
19th "	17,847	18.1	15.0	6.7	7.1	7.4	8.4	7.8	2.3	6.0	6.9	9.4	12.3	7.8	7.5	9.1	8.4
20th "	21,462	21.0	12.7	3.8	4.6	4.3	2.7	2.5	3.5	3.3	7.3	9.4	9.3	3.9	2.4	5.6	5.3
21st "	21,323	11.3	10.6	7.4	11.4	14.1	5.3	12.5	3.5	7.8	6.8	4.5	14.1	5.2	8.0	10.0	8.6
22d "	5,877	2.0	18.4	3.9	2.7	10.2	4.8	0.0	2.2	6.2	1.9	0.0	3.4	6.3	2.9	5.5	4.6
23d "	13,952	8.2	12.9	18.4	6.1	8.0	6.4	4.2	7.7	0.9	8.3	8.5	12.9	6.6	9.0	12.2	8.7
24th "	6,648	38.6	3.4	1.7	8.4	5.0	1.6	0.0	14.5	11.1	10.9	16.8	16.6	4.4	14.7	16.2	9.1
25th "	7,812	53.7	14.9	10.8	4.0	4.0	4.0	2.6	1.3	11.7	3.8	9.0	15.3	7.7	17.8	7.6	8.3
26th "	7,745	78.2	10.3	3.9	3.9	2.6	1.3	0.0	1.3	2.6	3.9	14.2	10.3	10.4	13.2	17.3	6.7
27th "	14,295	32.2	4.6	7.1	6.0	4.2	4.6	4.8	5.4	3.8	5.9	12.9	4.2	5.5	6.0	7.2	5.8
28th "	5,317	84.0	2.0	2.0	3.9	3.8	5.8	3.8	0.0	1.9	3.8	7.5	7.5	13.2	9.4	7.5	5.2
29th "	4,348	62.9	6.2	4.2	4.2	6.4	4.3	4.3	4.4	6.7	15.8	9.1	13.8	23.2	26.5	7.4	9.5
30th "	3,540	29.6	8.8	14.6	14.7	5.8	8.7	5.8	5.7	0.0	5.7	14.2	5.7	28.6	17.1	5.9	10.0
31st "	6,443	42.6	12.4	4.0	5.8	1.9	3.7	1.8	3.5	1.7	4.9	6.4	7.8	7.6	1.5	7.4	4.9
32d "	8,932	14.5	22.0	1.4	6.9	6.7	5.2	3.8	2.5	7.2	5.9	12.6	13.4	12.0	10.6	3.1	8.1
33d "	660	9.3	9.3	19.2	40.0	21.0	0.0	23.0	0.0	12.7	0.0	0.0	15.1	0.0	17.2	18.5	13.5
34th "	2,011	17.2	4.2	0.0	0.0	4.4	4.4	9.0	0.0	4.7	4.8	13.9	9.9	10.4	5.4	0.0	5.1
35th "	5,246	6.7	8.3	0.0	5.2	0.0	0.0	2.3	15.2	0.0	2.0	5.9	5.7	20.3	7.2	8.8	6.2
36th "	3,725	27.8	5.5	5.5	8.2	13.6	5.4	5.4	2.7	8.1	0.0	5.4	10.8	10.7	5.4	10.7	7.1
37th "	4,808	17.0	....	...	...	...	5.4	5.4	5.1	0.0	0.0	0.0	14.5	5.9	3.7	10.2	5.8
38th "	3,325	24.3	....	...	...	...	...	...	...	...	0.0	22.0	3.0	5.8	8.3	0.0	6.5
Not classified	.....	....	....	...	...	...	...	...	...	...	0.26	0.51	0.34	0.09	0.32	0.36	...
Total for Pittsburg	321,616	19.4	10.0	6.3	7.0	8.2	4.2	5.0	3.9	4.3	5.9	8.9	12.0	10.0	10.2	10.4	7.8
Total outside Pittsb'g	.....	....	3.2	3.9	3.1	3.1	1.5	2.7	2.3	2.0	1.3	2.1	2.4	2.4	3.1	2.8	2.5
Grand total	321,416	19.4	13.2	10.2	10.1	11.3	5.7	7.7	6.2	6.3	7.2	11.0	14.4	12.4	13.3	13.2	10.3
Wards 1st to 12th	.....	....	6.0	4.7	4.6	10.1	2.5	4.3	3.4	2.7	5.8	6.5	12.6	12.9	13.0	16.1	7.6
" 13th to 23d	.....	....	13.2	8.0	8.9	9.1	5.3	6.1	3.7	4.7	5.9	7.8	12.2	8.5	8.7	8.6	7.9
" 24th to 38th	.....	....	9.0	5.1	6.3	4.8	3.8	3.5	4.7	5.3	5.4	11.4	9.6	10.7	10.6	8.3	7.5
Death rate, Pittsburg, %.	.....	....	....	...	...	...	...	...	9.1	9.7	10.1	13.4	13.1	10.8	12.1	11.7	...
Death rate, % grand total	.....	....	20.1	21.7	20.6	13.6	13.3	13.4	13.0	13.1	11.4	14.4	13.9	12.2	13.8	12.9	14.2

The deaths "Not Classified" are the hospital deaths which cannot be referred back to the proper wards, the total rate for the whole city includes these deaths.
Populations for other than census years are estimated from census figures for 1890 and 1900.
Areas of wards used to obtain density of population do not include park and cemetery tracts.
"Outside Pittsburg" designates hospital cases from outside city and are included in the "Grand Total," and charged to whole city.
Death rate is obtained by dividing deaths per 10,000 by cases per 10,000, given for corresponding years in Table IV.
The 37th Ward annexed Oct. 31, 1894; 38th Ward annexed Jan. 14, 1898.

the records of deaths for Pittsburg are obtainable back to and including the year 1873.

Table II. gives these figures, arranged by months and about the same as the average at Lawrence, Mass., before the filter was installed. Recent years, when the statistics may be considered the in August, the figures for the next two months are high, but gradually fall to the figure for November, December and January, which may be

TABLE V.—DEATHS FROM TYPHOID FEVER IN ALLEGHENY, PA., PER 10,000 OF ESTIMATED POPULATION FOR EACH YEAR, FROM 1890 TO 1902, INCLUSIVE, ARRANGED BY WARDS.

	Population in 1900.	Persons per acre.	Deaths per 10,000 of population. 1890.[1]	1891.[2]	1892.[3]	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	Average for 13 yrs.
1st Ward	7,019	35.4	7.2	3.5	....	11.5	7.2	8.6	5.7	5.7	8.6	17.1	14.2	15.7	12.8	9.8
2d "	18,726	56.1	10.9	13.0	....	12.2	9.8	19.3	5.6	6.6	3.3	11.9	6.4	6.8	12.5	9.7
3d "	15,941	102.8	9.4	12.8	....	17.1	12.4	24.0	6.4	6.4	3.2	6.3	3.8	3.1	10.5	9.4
4th "	11,172	71.5	26.7	23.9	....	31.3	12.2	31.6	9.7	14.2	20.5	21.4	26.0	21.6	11.7	20.6
5th "	10,967	46.6	15.1	7.2	....	8.8	6.8	18.2	4.7	6.6	3.7	8.3	4.6	6.3	4.5	7.7
6th "	13,784	58.3	10.3	10.2	....	14.7	3.2	22.9	2.3	4.6	6.0	4.4	2.9	22.2	6.3	9.0
7th "	7,375	44.2	13.5	11.9	....	18.9	6.1	10.5	1.5	8.6	1.4	4.2	4.1	9.3	27.4	9.7
8th "	3,375	28.6	24.0	12.0	....	6.5	3.2	6.3	6.2	0.0	3.0	6.0	32.5	8.8	40.2	13.0
9th "	6,070	17.9	34.1	2.5	....	9.8	7.6	15.0	5.4	1.8	3.5	10.1	11.6	3.2	20.5	10.3
10th "	5,791	12.6	4.6	4.9	....	10.1	7.7	15.7	4.0	3.7	3.5	6.6	13.8	14.7	3.1	7.6
11th "	11,072	11.2	8.8	0.0	....	1.4	5.1	20.3	3.4	9.5	5.0	25.6	10.8	9.5	3.3	9.2
12th "	6,906	34.7	13.1	2.2	....	15.5	13.4	17.9	1.6	3.1	6.1	5.9	7.2	11.3	22.4	10.0
13th "	6,698	52.4	12.4	9.6	....	11.1	10.8	13.9	3.4	4.9	6.3	4.6	6.0	5.8	0.0	7.0
14th "	1,135	3.4	...	...	....	28.0	12.9	23.9	11.2	0.0	9.9	9.0	17.6	0.0	0.0	10.4
15th "	3,861	6.8	...	...	....	...	...	...	...	...	...	7.8	7.8	...	...	2.5
Whole city	129,896	28.2	13.9	10.7	13.3	14.3	8.6	19.3	4.9	6.5	5.8	10.6	9.3	10.2	11.0	10.0
Death rate, %.*	.....	....	30.2	23.3	18.7	10.9	13.2	13.1	14.4	13.3	14.1	15.1	13.7	14.7	16.8	15.0

*Obtained by dividing deaths per 10,000 for whole city by cases per 10,000 for whole city.
[1]For twelve months ending Feb. 28, 1891.
[2]For ten months ending Dec. 31, 1891. Yearly rate obtained by multiplying results for ten months by 12-10.
[3]For fourteen months ending Feb. 28, 1893. Yearly rate obtained by multiplying results for fourteen months by 12-14. All other years end on Feb. 28, of succeeding calendar years. The ward figures for this year not obtainable.
Population for other than census years are estimated from census figures for 1890 and 1900. Areas of wards used to obtain density of population do not include park and cemetery tracts.
Ward 14 annexed in September, 1892. Ward 15 separated from 10th Ward in 1899.

and also exhibits the annual rate per 10,000 and the average monthly rate. It will be seen from this table that the deaths from typhoid fever have most reliable, show higher rates than usual, especially during the past four years, which are among the highest for the whole 31 years.

TABLE VI.—Deaths from Typhoid Fever in Wilkinsburgh, Pa., From 1894 to 1903, Inclusive, Arranged by Months.

Months.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	Average for 10 yrs.
January	0	1	0	0	1	0	0	3	0	2	0.7
February	0	0	1	0	1	0	0	0	1	2	0.5
March	0	0	1	0	0	0	0	0	1	1	0.2
April	0	0	0	0	0	0	1	0	0	0	0.1
May	0	0	0	0	0	0	0	1	1	1	0.3
June	0	0	0	0	1	0	0	0	1	1	0.3
July	0	1	1	0	0	0	1	0	1	2	0.6
August	0	1	1	0	0	0	1	0	0	1	0.4
September	0	0	1	1	0	1	0	0	0	0	0.3
October	0	1	0	0	0	2	0	0	0	0	0.3
November	0	0	0	0	0	2	1	1	0	0	0.4
December	0	0	0	1	0	0	0	1	0	1	0.3
Total	0	4	5	2	3	5	4	6	4	11	4.4
Total, per 10,000	0	4.9	5.6	2.1	2.9	4.5	3.4	4.7	3.0	7.7	3.9

Population of Winkinsburgh was 4,662 in 1890, and 11,886 in 1900.
Density in 1900 was 11.9 per acre.
Population for other than census years, interpolated from census figures for 1890 and 1900.

TABLE VII.—Reported Cases of Typhoid Fever in Wilkinsburgh, Pa., for the Years 1901, 1902 and 1903, Arranged by Months.

Months.	1901.	1902.	1903.
January	..	4	18
February	..	..	61
March	1	1	4
April	3	2	2
May	9	2	5
June	3	1	5
July	0	3	3
August	0	1	6
September	5	5	2
October	0	2	..
November	1	1	3
December	7	11	4
Total of reported cases	29	33	113

For months where no figure is given, no cases were reported, thus the record is not complete.

never been less than 5.0 per 10,000 for any year, which figure is too high for any place having an unpolluted water supply. The general average

The monthly distribution, as given in Table II., and shown graphically by the diagram, Fig. 2, shows that the months following the summer

to 1898, and also by the cases for the same ten years.

It is hard to decide what is the cause of

this arrangement of monthly distribution, but perhaps the general traveling propensity of the people and going to new surroundings for vacations, becoming tired from such journeyings and thus more liable to illness, is a general contributing factor. Then, too, there is what may be called predisposition, or, more exactly, lack of resisting power; and the theory has been advanced that the intestines of people may be more easily attacked during the warm weather; in other words, whatever causes diarrhea to be general favors the attack of the typhoid bacillus and thus also causes typhoid fever to be abundant.

Local epidemics often cloud the evidences of such general average seasonal distribution, but Pittsburg, where the disease is continually endemic, shows this to a marked degree.

There is shown by the diagram, Fig. 3, the yearly relation of deaths from this disease in Pittsburg, determined by plotting the yearly death rate per 10,000 of population. The interesting picture is shown that maximum points correspond to periods of expansion and prosperity in the industries of the country; on the other hand, the low places correspond to business depression. The reason is plain; new work and rush of business brings many newcomers to Pittsburg, who are not accustomed to partake of impure water.

Before studying the typhoid data of Pittsburg in detail it will be well to understand the growth and characteristics of the city. The Old City (see map, Fig. 1), so-called, includes the present designated Wards 1, 2, 3 and 4, and these were the whole city until 1837. Districts now occupying Wards 5 to 12, inclusive, were added during the next nine years, and in 1846 the city comprised what is now the first 12 wards. Additional territory was added and in 1870 there were 23 wards, or what now lies between the two rivers, except the 37th Ward, which was added in 1894. The South Side Wards, Nos. 24 to 36, inclusive, were added in 1872, and Ward 38 in 1898.

Many of these wards have decreased in population in recent years, due to the people moving out to more attractive suburban wards, where there is plenty of room, and due to the growth of manufacturing and industrial places and business blocks down town and especially to development of railroad systems and yard room upon the South Side. Such wards are Nos. 1, 2, 3, 4, 5, 9, 10 and 15 of the old city, and 26, 29, 33 and 34 on the South Side. Most of the other wards have gained very markedly in population; the total increase for the whole city, from 1890 to 1900, was 83,000, or 35%.

The most densely populated wards are Nos. 5, 6, 7 and 8, which average about 150 persons per acre. The least dense are the three extreme East End Wards, Nos. 21, 22 and 23.

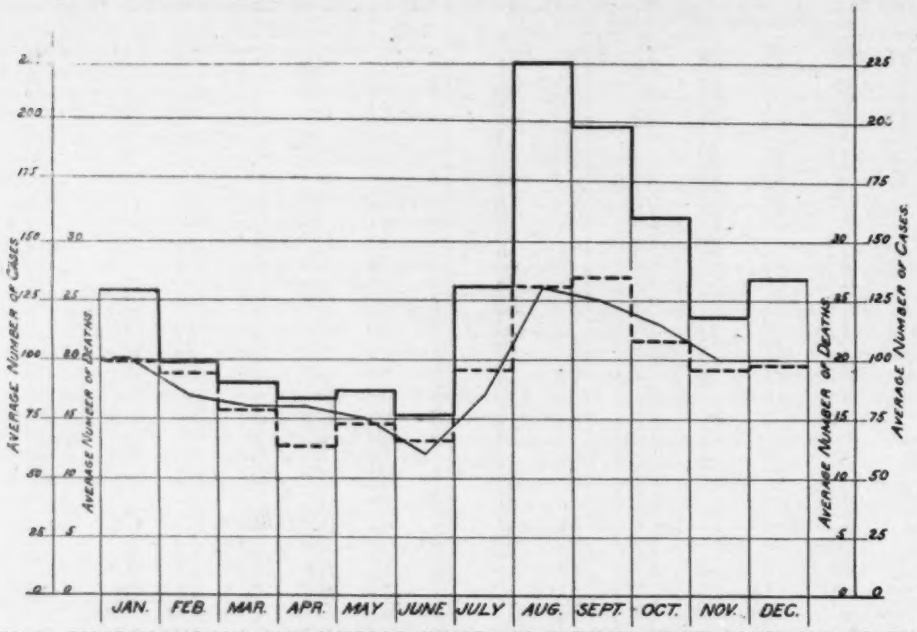

AVERAGE NUMBER OF CASES
AVERAGE NUMBER OF DEATHS
AVERAGE NUMBER OF DEATHS
AVERAGE NUMBER OF CASES
JAN. FEB. MAR. APR. MAY JUNE JULY AUG. SEPT. OCT. NOV. DEC.

FIG. 2. DIAGRAM SHOWING THE AVERAGE NUMBER OF TYPHOID FEVER CASES AND DEATHS IN PITTSBURG, PA., BY MONTHS, FOR THE YEARS 1889 TO 1898, INCLUSIVE; ALSO AVERAGE NUMBER OF DEATHS BY MONTHS FOR THE YEARS 1873 TO 1903, INCLUSIVE.

Heavy full line shows average number of cases, 1889 to 1898.
Heavy dotted line shows average number of deaths, 1889 to 1898.
Light full line shows average number of deaths, 1873 to 1903.

Wards 1, 2, 3 and 4 have largely been given up to manufacturing and industrial pursuits. Wards 5, 7 and 8 have in recent years been filled by a foreign population of various nationalities, mostly Italians, Hebrews, Greeks, and also Negroes. Ward 6 largely retains its original characteristics as a residence ward. Wards 9, 10 and 12 contain a large number of foreigners of the class that work in iron and steel mills. Wards 11, 13, 14, 15, 16 and 17 are residence wards, with local business upon the main streets and mills along the river. Wards 18, 19, 20, 21, 22 and 23 can be classed as suburban residence wards of ample house lots, but the last one has mills along the river front. Wards 24, 25, 26, 28 and 29 are residential, with mills along the river front and local stores on the main streets. Wards 33 and 34 are occupied almost entirely by the mills and railroads. Wards 27, 30, 31, 32, 35, 36 and 38 are typical residence districts, but considerable areas of some of these are not possible of habitation, on account of the steep slopes.

An inspection of Table III., showing the deaths per 10,000 from typhoid in Pittsburg by wards reveals the following: That which may be called the old city, that is, the first twelve wards, has not had as much typhoid fever as the new East End wards, either during the first years of the period we are considering or for the averages for the whole period. There may be several reasons for this, but probably the fact that almost all of the people in these wards have been until recent years old inhabitants and have become accustomed to the water, and thus relatively immune, has had something to do with it. The new East End Wards, on the other hand, have been populated by people lately coming to the city, who are unaccustomed to polluted water, and readily succumb to drinking the unpurified supply. The last four years indicate a different distribution and it may be due to a large increase of foreign population in some of the denser down-town wards and in the mill district of the 12th Ward.

Ward 37 has had somewhat less typhoid fever than the group of wards from 13 to 23, inclusive, and in this respect is in marked contrast to other East End Wards. The reason for this is a different water supply, which is more fully mentioned under "Wilkinsburgh Statistics." As it is frequently quoted that this ward is entirely without typhoid fever, which is not true, it is important that the records should be inspected with care. A comparison of the records for Ward 37 with those of Wards 13 to 23, inclusive, for the nine years from 1895 to 1903, inclusive, reveals the fact

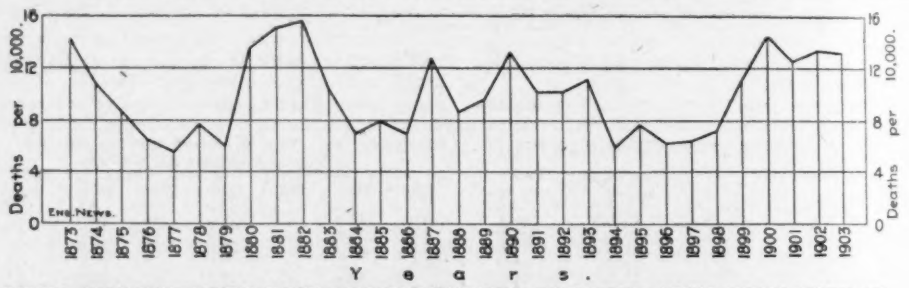


FIG. 3. DIAGRAM SHOWING DEATHS FROM TYPHOID FEVER PER 10,000 POPULATION AT PITTSBURG, PA., FOR EACH YEAR FROM 1873 TO 1903, INCLUSIVE.

TABLE II.—Deaths from Typhoid Fever in Pittsburg, Pa., from 1873 to 1903, Inclusive, Arranged by Months.

Years.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.	Rate per 10,000 population.
1873	9	9	7	16	34	15	15	28	18	18	15	7	191	14.4
1874	15	15	15	5	3	2	7	11	9	30	12	25	149	10.9
1875	13	5	12	4	8	4	6	12	18	20	12	6	120	8.6
1876	11	5	9	13	4	4	0	8	11	7	7	5	84	5.9
1877	5	3	0	6	4	2	4	6	8	15	9	9	71	4.9
1878	11	9	3	7	11	8	11	16	13	13	8	5	115	7.7
1879	8	6	10	4	3	1	3	7	15	12	14	8	91	5.9
1880	7	21	20	62	12	8	16	9	22	14	10	10	211	13.5
1881	11	10	9	20	12	6	25	34	37	30	26	19	248	15.1
1882	27	23	9	8	6	6	17	33	32	32	37	38	268	15.5
1883	38	26	25	5	7	5	8	18	17	13	10	16	188	10.4
1884	9	11	8	5	9	3	3	12	22	18	14	16	130	6.9
1885	11	5	6	6	14	6	18	22	27	14	17	8	154	7.8
1886	7	5	4	1	7	6	12	42	11	25	8	12	140	6.8
1887	10	8	14	8	14	13	22	33	35	32	28	52	269	12.6
1888	17	8	10	4	7	6	15	28	33	24	19	20	191	8.6
1889	22	7	8	5	5	10	26	33	29	30	21	22	218	9.5
1890	18	34	18	17	20	16	37	36	37	19	33	30	315	13.2
1891	27	15	22	13	17	11	23	36	33	25	20	7	249	10.1
1892	26	30	13	10	18	18	29	22	32	23	17	18	256	10.1
1893	16	13	36	20	25	23	25	47	31	21	22	13	292	11.3
1894	13	9	10	4	8	12	12	12	22	17	14	19	152	5.7
1895	34	18	6	15	9	8	9	22	17	32	24	19	213	7.7
1896	17	23	20	7	13	9	9	17	17	11	17	15	175	6.2
1897	16	15	12	16	13	10	10	16	25	18	9	24	184	6.3
1898	19	24	12	18	18	14	13	20	18	20	15	27	218	7.2
1899	31	22	22	25	21	15	21	44	38	33	31	39	342	11.0
1900	50	56	51	54	24	12	22	46	50	27	29	44	464	14.4
1901	39	35	37	32	42	23	42	53	30	40	22	21	416	12.4
1902	42	27	32	46	38	49	27	50	45	42	44	21	463	13.3
1903	42	32	46	53	49	31	33	41	30	21	41	55	474	13.2
Average, 31 years	20	17	16	16	15	12	17	26	25	23	20	20	227	10.0
Rate per 10,000 pop..	0.88	0.75	0.70	0.70	0.66	0.53	0.75	1.15	1.10	1.02	0.88	0.88	...	10.0

Population for other than census years are estimated from census figures for 1870, 1880, 1890, and 1900.

that the average of cases per 10,000 in this ward has been 83% of the average for the other wards, and the average of deaths has been 67% for the same time. During the last four years the conditions in this ward have not been as good as formerly.

The South Side Wards have generally had not so high a rate of cases or deaths as the North Side of the city. Why this is so it is not easy to say, as all determinations of the organic and bacterial composition of the water of the Monongahela River indicate that this water is somewhat more polluted than the Allegheny, as shown by Table I.

The water of the Monongahela River contains more sulphuric acid than that of the Allegheny, so much that occasionally all of the carbonates, expressed by the alkalinity, are neutralized. However, the numbers of bacteria appear just as high for these months of low water as in the Allegheny. It may be that the opportunities for sedimentation in this stream (they must be good to bring the total number of bacteria down to the limits near the average for the Allegheny, when the population of such large numbers is so near) are so sufficient and helpful as to deposit and thus remove a greater number of pathogenic bacteria from the water than of the total numbers. Then again, with the exception of some parts of the hill districts, the population of the South Side Wards has been largely of a constant character and permanent in respect that the old residents stay in place and become accustomed to the water.

For a few years prior to 1880, however, it had been noticed that typhoid fever was prevalent on the South Side and, during the above-named year, so great was the amount that in April there occurred 62 deaths for the whole city, the majority of which were on the South Side, a number of which has not since been exceeded. A special report was submitted upon this epidemic by a committee of the Board of Health, which at that early date, before the recent and rapid strides in bacteriology and epideminology, is an example of thoroughness and careful study. It was concluded, as a result of the investigations, that the specific infection of the disease was transmitted through the water supply from the sewage of the towns on the river above.

That typhoid fever is not by any means lessening, but is still keeping up at the high usual rate, may be seen from Table IV.

TABLE IV.—List of Reported Cases and Deaths from Typhoid Fever in Pittsburg (All Wards), Jan. 1 to Feb. 13, 1904.

Week beginning.	Cases.	Deaths.	Week beginning.	Cases.	Deaths.
Jan. 1*....	8	6	Jan. 31....	63	9
Jan. 3....	102	8	Feb. 7....	99	8
Jan. 10....	77	21			
Jan. 17....	90	6	Total....	516	69
Jan. 24....	77	11			

*Two days.

It may at first be thought that the high number for the week beginning Jan. 3 indicates a disturbance from the Kittanning outbreak, which occurred with its maximum from Dec. 6 to 27, 1903, but it must be noticed that our present table gives records for the whole city, and Table IV., in the Engineering News of Feb. 11, 1904, p. 127, giving the results of the wards supplied with Allegheny River water, is the true basis to use for comparison. In fact, our present table is useful, particularly as showing the general high numbers, which obtain all the time.

ALLEGHENY TYPHOID STATISTICS.

The characteristics of the different parts of Allegheny, while not so diversified as of Pittsburg, are worthy of mention. Ward 3, the most densely populated in the city, is a residence and boarding district, and inhabited, particularly in the eastern part, by people of German nationality. Wards 4, 2 and 6 rank next in order of density and are all residence wards. Ward 4 is devoted in some parts to business. The city's large hospital is also located in this ward. Wards 15, 11 and 10, which are the most sparsely inhabited, are suburban residence districts. The whole city is practically a residence district for persons employed in Pittsburg, Ward 4 being the only one in which much business is done.

While the city as a whole is more densely populated than Pittsburg, the figures being respectively 28.2 and 19.4 persons per acre, there are no wards as thickly inhabited as Wards 5, 6, 7 and 8 of Pittsburg.

It will be noticed, Table V., at first that the death rate from typhoid fever in Allegheny, that is, the percentage of deaths to cases, is high; more than in Pittsburg, or than appears reasonable. This is especially noticeable in the early years. The fact points unmistakably to the conclusion that not all of the cases of the disease are reported as typhoid fever.

The years 1893 and 1895 were particularly high, both in cases and deaths, but the death rate is lower than for most other years. It has been frequently noticed that at times of epidemic it becomes popular to report as typhoid fever all cases similar to that disease, and thus the death rate is made low and really is probably nearer the true figure. At times of normal conditions, physicians are prone to neglect to report cases of disease, and the practice is common to not report until death takes place. Thus it is known that all statistics based upon cases are not as reliable as those based upon deaths.

Careful studies of various typhoid fever epidemics have indicated a death rate of about 8% to 10%, sometimes as low as 6%. These figures appear in striking contrast with the figures given in our tables for Pittsburg and Allegheny, namely, 15.0 and 14.2%, respectively. We believe, however, that both are somewhat in error; the latter due to lack of reports of all cases as previously mentioned, the former due to the fact that many times deaths properly chargeable to an epidemic occur a long time after the same has been studied and statistics have been collected and deductions made.

While the years of 1897 and 1898 are low, occurring shortly after the Montrose pumping station was started, the later years are as high as ever, and it does not appear that the water from this source is much of an improvement as a steady beverage for the people.

In Allegheny no general statement can be made of the distribution of typhoid fever, some of those wards having a large number of cases are low in deaths, and the converse statement is also true. The disease appears to pass in waves over the various parts of the city. Wards 8 and 10 show an unusually high rate during the past three years. The high death rate in Ward 4 appears in striking contrast to the cases per 10,000, and is due to the fact that the Allegheny General Hospital is in this ward; cases coming from other wards are not charged to this ward, and the large number of typhoid fever patients received from outside the city, dying at this place, increase the total death rate of the ward.

WILKINSBURGH TYPHOID STATISTICS.

The Borough of Wilkinsburgh has been quite free from typhoid fever (as has been Ward 37, of Pittsburg), the death rate per 10,000 of population being about 40% of that of Pittsburg.

During the last year, however, an increase is noticed (see Tables VI. and VII.) in the months of January and February. Greater drafts have been made upon the cribs of the water-works, and probably the water has not been as well strained as heretofore. In fact, during the period of much typhoid fever, the water company issued a notice that it had occasion to believe that the intake had been disturbed and thus the water was not likely to be as good as usual. The people were advised to boil the water until further notice. This action should not pass without comment. Too often water companies, and sometimes even city officials, are backward about coming out and frankly stating facts and conditions as they exist, on the plea that unjust criticism is directed against insignificant acts, and it is best not to give away anything which can be used against the much-abused official. This, however, is not a broad view to take, or the humane one, and as it is easier to find fault than do the act, the Pennsylvania Water Co. is to be commended that it faced the situation and informed its customers.

Later in the season, when the stage of the river allowed a diver to work, it was found that there were some holes and openings into the new crib where some water had a ready access to the intake, without passing through sand or gravel material. It is said that these holes were made by sand-boat dredges. It should be stated that analyses, made at the time of the prevalence of the typhoid fever, showed the water to be of the usual condition without many bacteria. Also it was thought by the authorities that some of the milk supplied in the borough was open to suspicion as being a possible source of the infection.

At the present time, that is, from the first of the year, Wilkinsburgh seems to be having another scourge of the disease. The ordinary normal reports showed 14 cases for the month of January and 12 cases for February, up to Saturday, the 13th inst. However, the local Board of Health, believing that the conditions were not fully known and that much information had not come to hand, made a special effort to secure from all physicians an accurate statement of the number of cases. The results showed that 75 cases were under treatment and diagnosed as typhoid fever at that date, thus revealing the paucity of the data as usually obtained. This careful canvass of the situation brought out the fact that in all there had been 126 cases from Jan. 1 to Feb. 13. There have been only four deaths during the present year to date. The boroughs of Edgewood, Swissvale, Rankin and North Braddock are also supplied by this company.

TYPHOID IN EDGEWOOD AND SWISSVALE.

Information in regard to prevalence of typhoid fever in these communities has been obtained for Edgewood and Swissvale only. These boroughs immediately adjoin Wilkinsburgh on the south, toward the Monongahela River, and obtain their supply from the Pennsylvania Water Co. They are residence sections and comparatively sparsely populated. Probably about one-half of the people in both boroughs are employed out of town; many of those in Swissvale going to the mills and factories to the east; in Edgewood the relative numbers going to Pittsburg and to the factories to the east are perhaps evenly divided.

The statistics in regard to Edgewood are given in Table VIII., and show a less amount of typhoid fever than the adjoining borough of Wilkinsburg. The statistics for Swissvale, Table IX., are more meager, but seem to indicate a greater prevalence of typhoid in this borough than in Edgewood.* It is possible that a greater proportion of people in Wilkinsburgh do business and work in Pittsburg than in other boroughs supplied by this company and this may explain why the typhoid fever rate is higher there than in the adjoining boroughs.

TABLE VIII.—Reported Cases of Typhoid Fever in Edgewood, Pa., from 1896 to 1903, Inclusive, Arranged by Months.

	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	Average.
Jan.	2	2	1	0	0	0	1	0	0.75
Feb.	1	0	0	0	0	2	0	5	1.00
Mar.	0	0	0	0	0	0	1	0	.12
April ...	0	0	0	0	0	0	0	0	.0
May	0	0	0	0	0	0	0	0	.0
June	0	0	0	0	0	0	0	0	.0
July	0	0	0	0	0	0	0	0	.0
Aug.	1	0	0	0	0	0	0	0	.12
Sept. ...	0	1	1	0	0	0	0	1	.38
Oct.	0	0	0	1	1	1	0	0	.38
Nov.	0	0	0	1	0	0	0	0	.12
Dec.	0	0	0	0	0	0	0	0	.0
Total ..	4	3	2	2	1	3	2	6	2.85
Pr 10,000	43	31	19	18	9	25	16	46	26.0
Deaths ..	0	1	0	0	0	0	0	0	

TABLE IX.—Reported Cases of Typhoid Fever in Swissvale, Pa., for the Years 1902 and 1903, Arranged by Months.

Months.	1902.	1903.	Months.	1902.	1903.
January	0	3	October	0	0
February ..	0	0	November...	0	1
March	1	2	December...	4	0
April	0	2			
May	0	1	Total....	16	31
June	0	0	Per 10,000...	45	69
July	2	8	Deaths.....	1	3
August	7	4	Per 10,000..	2.8	6.7
September...	2	10			

CONCLUSIONS.

Pittsburg and Allegheny both have typhoid fever and death rates far above what should obtain if the water supply were unpolluted, and these rates have been constant for many years. Wilkinsburgh and Ward 37 of Pittsburg have been favored in regard to the character of the water, and typhoid fever has been less prevalent than in the other portions of the territory under consideration. Probably some of the cases in Wilkinsburgh and in Ward 37 can be traced to the use during business hours of water in Pittsburg, as Wilkinsburgh is a place of little manufacturing and business, consisting largely of residences.

Another deduction is the lack of typhoid sta-

*The estimated population for Swissvale, however, are quite approximate, as the growth has been so rapid it is not possible to calculate these figures very closely.

tistics, especially as to cases. As only about 10% to 12% of the persons who are taken ill of this disease die, the true cost to the community is represented by the cases caused, rather than the deaths. In few cities are vital statistics so well kept as in Pittsburg, and even there it is recognized that many cases of typhoid fever and other infectious diseases are not reported. There has been a large amount of sorrow and death caused by the ravages of this disease during the past few months, but perhaps the lesson will be well learned and good come if it will lead to more accurate statistics, better understanding of the disease and its treatment, as regards thorough disinfection, and last, but most of all, in strengthening the hands of the health authorities, both local and state, in having care not only of water supplies and their protection, but also of the disposal of sewage.

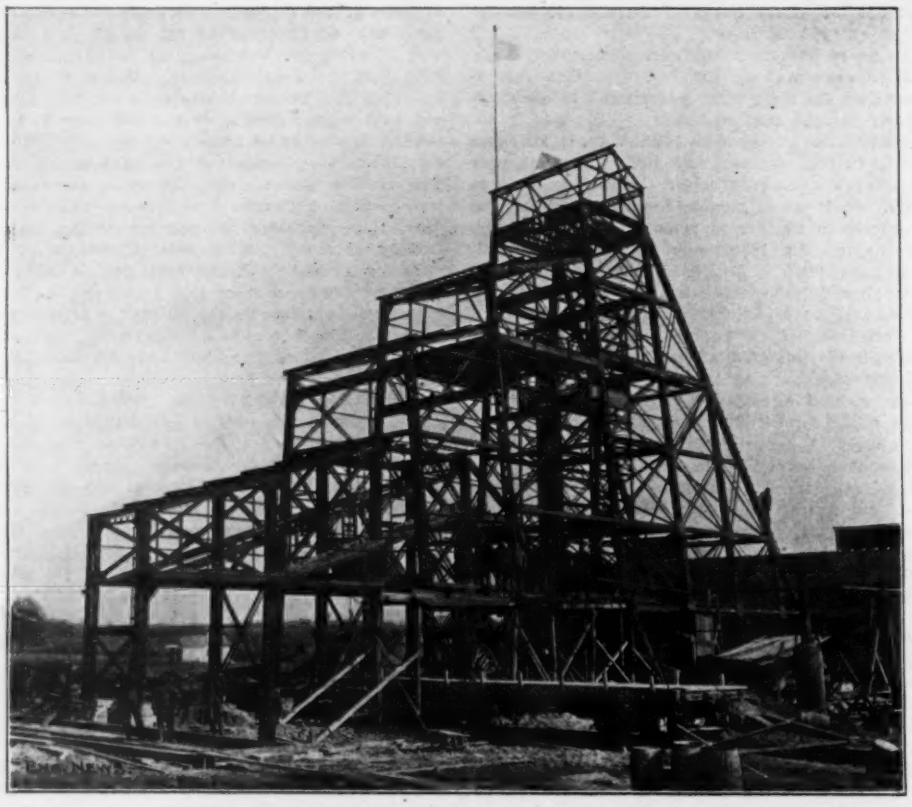


FIG. 1. STEEL TIPPLE OF COAL MINE ON THE SOUTHERN INDIANA RY.

CONSTRUCTION WORK ON THE SOUTHERN INDIANA RAILWAY.

The Southern Indiana Ry. extends southeast and east across the State of Indiana, from Terre Haute to Westport, a distance of 148 miles, and intersects a number of other railways. Its principal freight traffic is in Bedford stone from the celebrated quarries at Bedford, Ind., and coal from the mines in the district immediately south of Terre Haute. In this district is an immense area of coal lands, and there are now about 30 mines served by this railway, while new mines are continually being put down. Nearly all of these mines will have an ultimate capacity of 1,500 tons per day. A steel tipple at one of the new mines is shown in Fig. 1. It takes from 3 to 5 years for a mine to reach its full capacity, and all the mines on the road (except three or four) are now less than two years old. Each mine is now in condition to deliver from 200 to 1,100 tons per day, according to the underground development, and at the present time the road hauls from 150,000 to 200,000 tons of coal per month. Part of this is delivered to roads running north from Terre Haute to Chicago, while the remainder is carried into the Indiana gas belt, the gradual failure of the natural gas supply rendering the manufacturing industries more or less dependent upon coal. In view of the heavy Chicago coal traffic, it is proposed to build a line north from Terre Haute to Chicago, about 180 miles, while at Terre Haute a belt line has been built so as to send through traffic around the city and avoid congestion of traffic at the city terminals and yards.

The construction work which we describe in this article is on the branch lines now being built in the coal district above noted, lying principally in Sullivan and Greene counties, and shown on the accompanying map, Fig. 2. There are three of these lines, aggregating 38 miles. At Blackhawk, where the line to Hymera and Sullivan joins the main line, a yard is being laid out that will hold upwards of 500 cars. This will be used for making up the coal trains for the belt line. The first yard track is 20 ft. from the main track and the body tracks are 14 ft. c. to c. The maximum grades on these branches are 1% for the Sullivan and Glendora branches, and 0.6% for the Hymera branch, while the sharpest curves are 2°, the aim being to haul trains of 25 and 45 cars, respectively (30 tons per car), with the standard 70-ton ten-wheel freight engines. The track is laid with 70-lb. rails of the Am. Soc. C. E. section, and oak ties. Some of these ties came from Kentucky and cost 50 cts. each; the balance are obtained along the main line of the railway.

In planning for the construction of these lines it was decided to carry on the work by day labor, under the charge of the company's engineers. We are indebted to Mr. Geo. H. Cooke, Assistant Engineer, for much information and for facilities for inspecting the work in progress.

During the past season about ten camps have been operated, and the number of men employed has been from 75 to 125. The grading has been done largely by scrapers and teams hired from local farmers, the company paying $3.50 per day for a scraper team, and $1.50 and $1.75 per day for labor, and having its own foreman in charge of each grading gang. In addition to this, however, the company owns a large equipment of scrapers and 30 mule teams, hiring labor along the line at $1.50 and $1.75 per day. This latter practice involves a complete camp organization, with maintenance of stable outfits, blacksmith and other facilities, but it is found to be more satisfactory and economical than merely hiring the teams, as with the latter plan there is daily uncertainty as to the number of teams that will be available. For these reasons it is intended to increase the company's equipment next year, and the engineers are in favor of operating the camp boarding and commissary departments, which are now let to boarding contractors.

The company also owns a stone quarry for ballast, with a crusher plant of 30 cars daily capacity, a gravel pit, three Bucyrus steam shovels and 20 side-dump cars of 10 cu. yds. capacity, operated in two 10-car trains. Each car has four tilting boxes, two on each side, which are dumped by releasing a catch and raising up the rear of the box with a bar, the arrangement being somewhat similar to that of the Page car described in our issue of Dec. 22, 1898. The cars are rated at 30 tons carrying capacity, weigh 29,000 lbs. empty, and were built by the Barney & Smith Co., of Dayton, O. They are fitted with air brakes and the trains are operated by ten-wheel engines

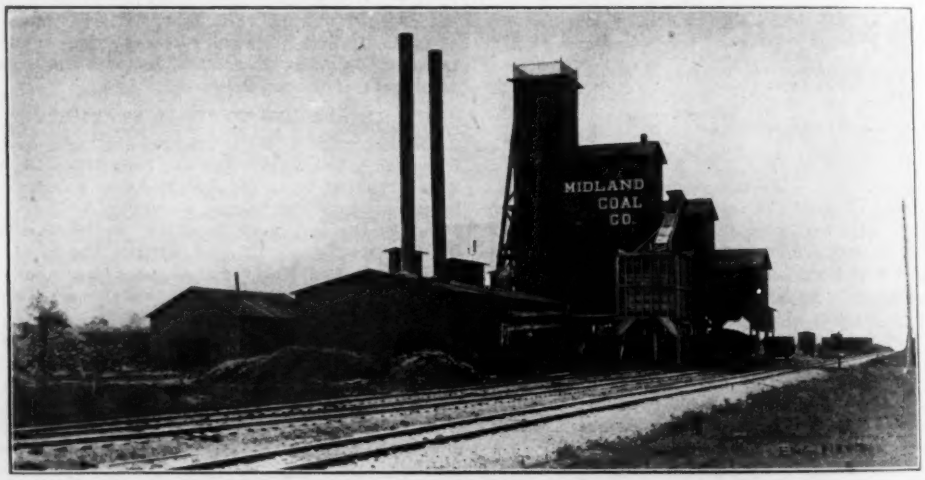


FIG. 4. TIPPLE AND LOADING TRACKS AT COAL MINE; SOUTHERN INDIANA RY.

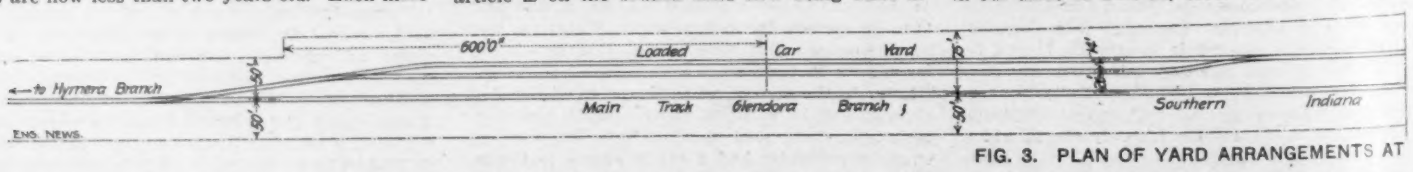


FIG. 3. PLAN OF YARD ARRANGEMENTS AT

of sufficient power to handle them readily and promptly at the pit and on the road. The cost for labor on the steam shovels is about $15 per day.

The material is mainly clay and gravel, and an allowance of 10% is made for shrinkage at the banks. The width of roadbed is 20 ft. on the banks and 28 ft. in cuts, which allows for ample ditches. Where the work is done by steam shovel,

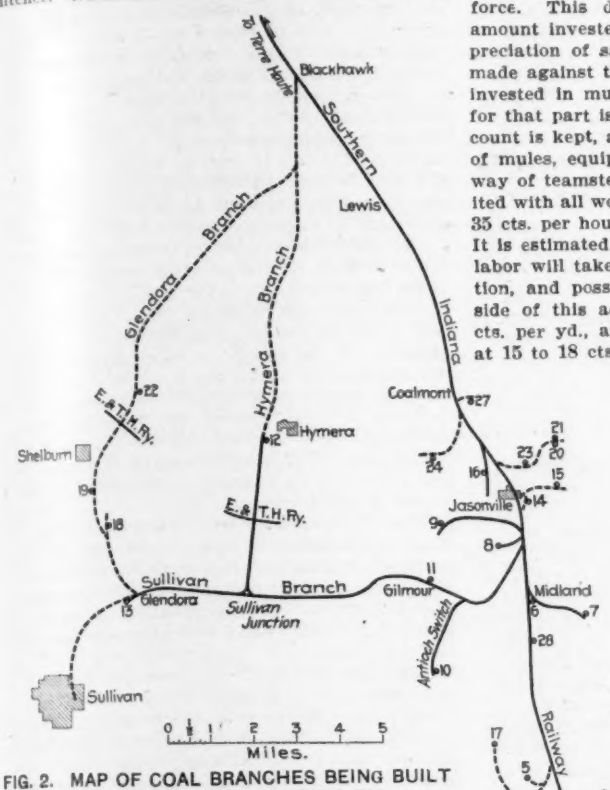


FIG. 2. MAP OF COAL BRANCHES BEING BUILT BY THE SOUTHERN INDIANA RY.

1. Island Valley Coal Co.
2. L. T. Dickason Coal Co.
3. Black Creek Coal Co.
4. Hoosier Coal Co. Mine No. 1.
5. Hoosier Coal Co. Mine No. 2.
6. Midland Coal Co.
7. Tower Hill Coal Co.
8. Letsinger Coal Co.
9. Lattas Creek Coal Co.
10. Antioch Coal Co.
11. Indiana Southern Coal Co.
12. Hymera Coal Mining Co.
13. W. S. Bogle.
14. Fry Coal & Mining Co.
15. Northwest Coal Co.
16. Green Valley Coal Co.
17. Coal Bluff Mining Co.
18. T. C. Keller.
19. Mammoth Vein Coal Co.
20. Vivian Coal and Mining Co. Mine No. 1.
21. Vivian Coal and Mining Co. Mine No. 2.
22. North Jackson Hill Coal Mining Co.
23. Island Valley Coal Co.
24. Jasonville Coal Co. (Krause).
25. Island Coal Co.
26. North Linton.
27. Lewis Coal & Mining Co.
28. Pennsylvania & Indiana Coal Co.

a narrow cut or gullet is first made for the track, and then the shovel cuts its way back, widening out the cut and loading cars which stand on the track. No construction trestles are used, the track being first laid on the ground to carry the gravel trains, and then being continually raised as the bank is formed by the dump cars. For scraper work, the banks are built from the ends in the usual way. In finishing up the work, the ditches are trimmed and cleaned out by slips or drag scrapers, which is easily done after the men have been instructed. The cross-sectioning for this work is done by an instrument man and three men.

There are very few trestles, solid banks with 12-in. to 30-in. iron pipe culverts being generally built, and it is found that with a haul not exceeding five miles the pipe can be hauled and laid at $1 to $1.50 per ton.

The cost of grading is one of the most important features, and it is found that this cost is from 4 to 5 cts. lower than for similar work done by contract at points where the company did not find it convenient to work on account of insufficient force. This does not include interest on the amount invested in tools or anything for the depreciation of same. Neither is there any charge made against the work for interest on the money invested in mules, harness and camp equipment, for that part is handled in this way: A team account is kept, and to this account is charged cost of mules, equipment, feed, and all service in the way of teamsters, etc. Then the account is credited with all work done by the teams at the rate of 35 cts. per hour, the same as paid outside teams. It is estimated that the amount credited for their labor will take care of the interest and depreciation, and possibly leave something on the profit side of this account. Light work is done at 10 cts. per yd., and large 15 and 20-ft. banks built at 15 to 18 cts. per yd. This is inclusive of road crossings and tile drains to carry the ditches under the crossings, while with contract work this would all be extra. It also includes 500 ft. free haul, while the contract includes no free haul. Many of the small contracts are let by what is called "two way" work, that is, all excavation put into embankment is paid double and in this way it may be considered that there is no free haul. The cost is also lower where work is done with the company's teams than where it is done with the hired teams.

From the engineer's records we take the figures given below. Table No. 1 shows a comparison of work done in 1899 with that done in 1903, all by day labor. In 1899 foremen were paid $65 per month; teams, $2.75 per day, and labor $1.25 per day. In 1903 foremen received the same pay, but $3.50 was paid for teams and $1.50 and $1.75 for labor. In spite of these increased rates the cost of the work averaged about the same, owing to greater experience and improved organization.

As so many coal mines are served by this railway, a standard track plan for sidings has been adopted, and is shown in Fig. 3. The alinement varies at different points according to the alinement of the main track, and the topography necessitates cuts and banks in some cases to give the requisite grade to the gravity tracks. At one end of the layout are three tracks (about 600 ft. long) for empty cars, with a grade of about 1¼% towards the shaft. The ladder tracks opens into four loading tracks at the shaft, to allow of loading four different sizes of coal by chutes from the overhead tipple, as shown in Fig. 4. Box cars are loaded by a special machine (Engineering News, Aug. 15, 1901). A box-car loader is generally placed between the main (or "run around") track and the first track under the tipple, and is so arranged that it can load box cars when placed on this first tipple track. The grade of tracks past the shaft is about 1.25% to 1.4%, and the second ladder track then opens into two or three tracks for loaded cars, having a grade of about 0.75%, or just enough to enable the cars loaded at the shaft to be run by gravity into the yard. The loaded car tracks are designed to hold the same number of cars as the empty car tracks above the tipple, enough for a full day's work. For these yards, No. 8 frogs are generally used, but sometimes No. 6 frogs are used where the grade is sufficient to overcome the extra curvature.

The coal company pays the cost of grading, and the railway company provides the tracks. The latter also delivers empty cars into the upper yard and hauls away the loaded cars from the lower yard, the mine employees handling the cars by gravity to and from the shaft. The mines are connected with division points by telephone, and the railway officials are thus notified of the cars ready to be taken away. One switch engine will serve three or four mines, taking the cars to the division point, where through trains are made up. The car numbers, weights, etc., are also noted by telephone

TABLE NO. I.—Earthwork; Southern Indiana Ry.

	1899		1903		
	Cu. yds. hauled.	Cost, cu. yd., cts.	Cu. yds. hauled.	Cost, cu. yd., cts.	Cu. yds. team, pr day.
July.....	43,303	11.39	48,884	14.60	38.0
Aug.....	89,499	13.53	99,893	12.03	37.5
Sept.....	114,047	11.69	102,763	13.56	33.3
Oct.....	83,319	9.97	86,776	13.85	33.8
Nov.....	67,374	11.39	5,757	12.10	32.0

TABLE NO. II.—Grading Estimate for October, 1903; Southern Indiana Ry.

Cu. yds. by each gang.	Pay roll.	Cost, per cu. yd., cts.	Location of work.
8,363	$1,422.60	17.0	Blackhawk Branch.
10,493*	1,281.25	12.2	" "
6,196	878.37	14.2	" "
6,360*	786.37	12.7	" "
10,316*	1,092.02	10.6	" "
6,703	980.59	14.6	" "
1,468	206.45	14.0	" "
7,819	1,309.57	16.8	" "
15,556	1,805.34	11.6	Mammoth Mine.
5,390	1,000.39	18.5	Glendora Branch.
1,389	108.71	7.7	" "
6,723	1,145.06	17.0	No. Jackson Hill.
85,776	$12,016.72	13.85	

*Company's mule teams.

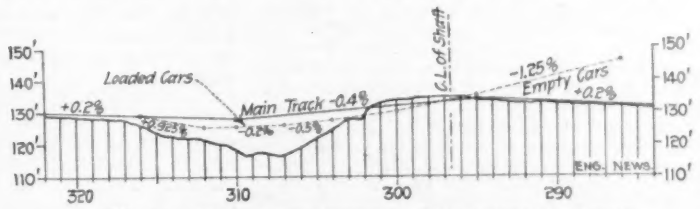


FIG. 3A. CONDENSED PROFILE OF STANDARD SIDING.

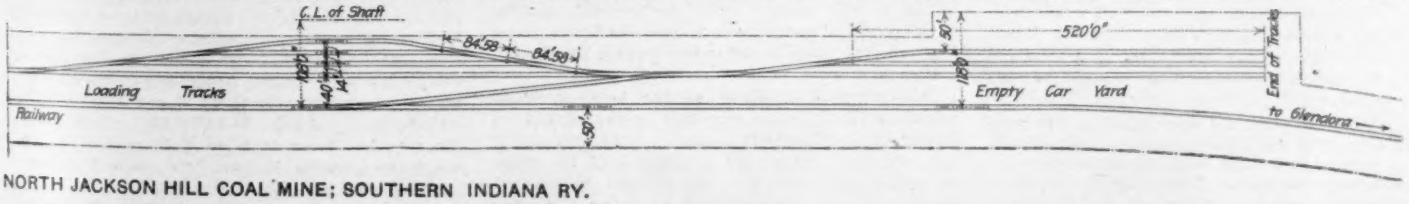
A REVIEW OF THE AMERICAN CEMENT INDUSTRY IN 1902-1903.

By Edwin C. Eckel,* Assoc. Am. Soc. C. E.

The official figures for the cement production of 1902 have just been published by the Division of Mineral Resources of the U. S. Geological Survey; and it seems probable that a discussion of these figures, bringing out the facts which can be derived from the statistics, but which do not appear on the face of the returns, will be of interest to engineers.

In addition to these deductions from statistics, the writer has called attention to certain features of the cement industry during the past few years, which seem of sufficient importance to be discussed in Engineering News. Many of these feat-

*U. S. Geological Survey, Washington, D. C.



NORTH JACKSON HILL COAL MINE; SOUTHERN INDIANA RY.

ures were brought to his attention in the course of visits, during 1903, to most of the cement producing districts of the United States. This field work was undertaken with a view to preparing a report on the "Cement Materials of the United States," to be published during the coming year as a Survey bulletin. In the course of the work, however, many data of interest, bearing on cement technology or trade, and therefore not strictly included in the subject of his official report, were obtained. For most valuable aid in this investigation, and for the courtesies extended to him both in correspondence and during his visits to the various plants, the writer gratefully acknowledges his indebtedness to his friends in the cement industry—the managers and chemists who have brought American Portland cement from the discouraging situation of 1874 to the brilliant success of the present year.

PROGRESS IN THE CEMENT TRADE.

THE CEMENT PRODUCTION OF 1902.—From the recently issued report of the U. S. Geological Survey the following figures are obtained:

The total production of cements in the United States during 1902 was 25,753,504 bbls., an increase of 5,684,767 bbls. over the quantity produced during the preceding year. The value of this production was $25,366,380.

Of the entire quantity, 17,230,644 bbls. were Portland, valued at $20,864,078; 8,044,305 bbls. were natural cement, valued at $4,076,630, and 478,555 bbls. were puzzolan or slag cement, valued at $425,672.

It is of interest here to note that in 1892, just ten years ago, the entire production of cement in the United States was but 8,758,621 bbls., of which 8,211,181 bbls. were natural cement; and only 547,440 bbls. were Portland.

The production of Portland cement during 1900, 1901 and 1902, from the various states, is given in detail in the following table.

TABLE I.—Production of Portland Cement in the United States in 1900, 1901, and 1902.

State.	1900. Number of works.	1900. Quantity.	1900. Value, not including packages.	1901.a Number of works.	1901.a Quantity.	1901.a Value, not including packages.	1902.a Number of works.	1902.a Quantity.	1902.a Value, not including packages.
		Barrels.			Barrels.			Barrels.	
Alabama							1		
Arkansas	1	40,000	$80,000	1			1		
California	1	44,500	89,120	b1	146,000	$263,000	2	296,150	$521,950
Colorado	1	35,700	71,425	c1	366,000	641,500	2	92,041	165,676
Georgia							1		
Illinois	3	240,441	308,102	4	322,625	382,617	4	797,721	997,641
Indiana	1	52,000	87,880	3	219,402	340,303	6	393,756	638,344
Kansas	1	60,000	135,000	1			1	929,000	1,067,224
Michigan	6	664,750	830,940	10	1,322,710	1,193,180	10	1,577,056	2,134,256
Missouri							1		
New Jersey	2	2,350,252	2,585,252	2	1,613,000	1,450,000	2	2,122,150	2,585,950
New York	9	665,252	862,280	7	627,228	627,228	10	1,154,667	1,521,502
North Dakota	1	400	1,200	1					
Ohio	6	554,215	627,702	47	660,622	758,067	7	662,113	659,971
Pennsylvania	16	4,264,417	4,994,627	23	7,266,849	6,962,259	13	6,776,464	10,150,422
South Dakota	1	30,000	70,000	1			1		
Texas	2	55,000	82,000	e2	235,702	235,627	2	365,220	554,000
Utah	1	70,000	175,000	1			1		
Virginia	1	28,470	73,060	1			1	334,660	435,366
Total	60	9,663,020	9,366,355	86	13,713,235	12,922,980	65	17,230,644	20,864,078

a The states combined for 1902 are mentioned in the text.
b Includes product of the single plant in Utah.
c Includes product of the only Portland cement plant in Kansas.
d Includes product of the only Portland cement plant in Virginia.
e Includes product of the single plant in South Dakota.

In this table the output in 1902 of the single Portland cement plant in Alabama is combined with the production of Georgia and Virginia to avoid disclosing individual figures; for like reasons the output of the only Portland cement plant in Missouri (which in 1902 made simply an experimental run) is included with Kansas and South Dakota, and the output of the single plant in Utah is combined with California. In each case the total figures are placed against the name of that state contributing the largest proportion of the entire amount. The three new states to enter this table for 1902 as producers of Portland cement are Alabama, Georgia, and Missouri. New Mexico is dropped, owing to the fact that the plant in this territory is definitely abandoned, so far as the cement industry is concerned.

AMOUNT OF PORTLAND CEMENTS PRODUCED FROM DIFFERENT RAW MATERIALS.—From the totals given in various volumes of the "Mineral Resources" the writer has calculated the amount made from each of six different combinations of raw materials, and recorded them in the following table. The six combinations are as follows:

1. Argillaceous limestone and pure limestone. This combination is used in the Lehigh District of Pennsylvania and New Jersey, in Utah and at one California plant.

2. Marl and clay or shale. Used extensively in Michigan, and to a less extent in Indiana, Ohio and New York.

3. Soft limestone and clay, or shale. Used in Alabama, Arkansas, Texas, South Dakota and Colorado.

4. Hard limestone and clay, shale or slate. Used in almost every cement producing state.

5. Alkali waste and clay. Used in Michigan only.

6. Slag and limestone. Used in Illinois, Ohio and Pennsylvania.

The principal fact brought out by the tabulation of these data is the remarkable and steady increase in the amount of Portland cement produced from pure hard limestone, mixed with clay, shale or slate.

TABLE II.—Production of Portland Cement from Various Materials.

	Type 1. Argillaceous limestone and pure limestone		Type 2.* Marl and clay		Type 3. Soft limestone and clay		Type 4.† Hard limestone and clay	
	bbls.	%.	bbls.	%.	bbls.	%.	bbls.	%.
1898.	2,682,304	74.9	545,372	15.2	39,000	1.1	315,608	8.8
1899.	4,010,132	70.9	1,095,934	19.4	88,200	1.6	458,000	8.1
1900.	5,919,629	70.3	1,444,797	17.1	184,400	2.2	874,715	10.4
1901.	8,503,800	66.8	2,001,200	15.8	495,752	3.9	1,710,773	13.5
1902.	10,923,922	63.6	2,214,519	12.9	372,413	2.2	3,673,790	21.3

*Including also the product from alkali waste and clay.
†Including also the product from slag and limestone.

Early in 1903 the writer prepared an estimate* of the production of Portland cement from various raw materials in 1902. Comparison of this estimate with the figures given above, which are deduced from the official statement just published, show that the early estimate was remarkably close to the truth so far as the production from argillaceous limestone and clay and from marl and clay was concerned, but that the production from limestone and clay was greatly underestimated.

PRODUCTION OF CEMENT IN THE LEHIGH DISTRICT.—Table III. has been compiled from data given in the various annual volumes issued by the United States Geological Survey, on the "Mineral Resources of the United States." It shows the very important part played by the Lehigh District in the Portland cement production of the country. It also shows that the relative importance of the district reached its maximum in 1897, when it produced 74.8% of all the Portland cement manufactured in the United States. Since that year, though the production of the Lehigh district has steadily increased, production in other parts of the country has more than kept pace with it. In consequence, the percentage (of the total United States product) manufactured in the Lehigh district has grown slightly smaller each year since 1897.

TABLE III.—Portland Cement Production, 1890-1902.

	Lehigh Dist.		Entire United States.		
Year.	No. of plants.	No. of bbls.	No. of plants.	No. of bbls.	Value.	*Per cent.
1890..	5	201,000	16	335,500	$439,050	60.0
1891..	5	248,500	17	454,813	1,067,429	54.7
1892..	5	280,840	16	547,440	1,152,600	51.3
1893..	5	265,317	19	590,652	1,158,138	44.9
1894..	7	485,829	24	798,757	1,383,473	60.8
1895..	8	634,276	22	990,324	1,586,830	64.0
1896..	8	1,048,154	26	1,543,023	2,424,011	68.1
1897..	8	2,002,059	29	2,677,775	4,315,891	74.8
1898..	9	2,674,304	31	3,692,284	5,970,773	72.4
1899..	11	4,110,132	36	5,652,266	8,074,371	72.7
1900..	15	6,153,629	50	8,482,020	9,280,525	72.6
1901..	16	8,595,340	56	12,711,225	12,532,360	67.7
1902..	17	10,829,922	65	17,230,644	20,864,078	62.8

*Percentage of total product manufactured in the Lehigh District.

TRADE CONDITIONS IN 1903.—The year 1903 opened with the brightest possible prospects for the American Portland cement industry. Stocks on hand were not over large, while a number of very important engineering works were in progress or in prospect, all of which would require large quantities of Portland cement. The outlook in the building trade in the large eastern cities was also very favorable, seeming to forecast a highly prosperous year.

Before the cement mills had fairly begun operations for the season of 1903, however, the situation had entirely changed. Labor conditions had become acute in the eastern and central states, and long and serious strikes took place. This resulted in the practical cessation of building operations in the eastern cities for several months, in the entire abandonment of many building plans, and in great delay in those which were finally undertaken.

This crippled condition of the building trade naturally reacted very promptly on the cement industry in the East, and caused a very dull spring and summer. After the settlement of the more extensive labor troubles, the outlook brightened somewhat, but not sufficient to make the year satisfactory to the eastern cement mills. Late in the year a shut-down of six weeks, for all mills, was agreed upon by the members of the cement manufacturers' association. While the shut-down is "for the purpose of making necessary repairs," it will operate to reduce the stocks which would otherwise have been carried over into the new year; and will therefore improve the prospects of the cement market for 1904.

*Engineering News, Vol. 49, p. 339-340. April 16, 1903.

West of the Mississippi River entirely different conditions prevailed. Cement mills had never been overbuilt in this district—in fact, they have never been able to supply the demand. This is demonstrated by the fact that foreign cements—even the poorer English and Belgian brands—still find a foothold in the southwest and on the Pacific coast. During 1903 four new cement plants went into operation west of the Mississippi River, while several of the existing plants were extensively remodeled and enlarged. For most of these western plants, and particularly for those in California and Kansas, the year was highly successful.

NEW ENGLAND.—No plants are as yet established in New England, though considerable interest has been shown in the area. The only available low-magnesia limestone beds of sufficient extent occur in Vermont and Maine. The marble quarries of western Vermont furnish a large amount of good material, but fuel is expensive and the nearby clays are not particularly satisfactory. In Maine many of the limestones so extensively used for lime-burning at Rockland, Thomaston and other points are low in magnesia and occur in large quantity, well located in regard to water transportation.

NEW YORK.—In New York two new plants went into operation. One, in the western part of the state, uses marl in a dry process. The other is the large and well planned mill of the Hudson Portland Cement Co., described in Engineering News of July 23, 1903, which uses limestone with clay and shale.

LEHIGH DISTRICT.—The event of the year in this district is the entrance on the market of cement made by the Edison Cement Co., of Stewartsville, N. J. Most of the available cement rock deposits in the original Lehigh district are now strongly held by existing companies, or, at prohibitive prices, by their owners. The tendency in the future will therefore probably be in the direction of locating new plants on the outskirts of the district. The cement rock deposits are known to occur all the way across New Jersey, and, in the opposite direction, across Pennsylvania and Maryland into Virginia. The folly of locating new plants in the midst of an area already crowded with cement mills seems to be evident.

MICHIGAN AND THE MARL PLANTS.—The decreasing percentage of the total amount of Portland cement produced from marl was to have been expected. With present methods it is impossible for a marl plant to live in competition with a plant using dry materials. It is very improbable that the number of marl plants will increase much; and at present it seems possible that some of those now existing will be converted into plants using limestone in place of marl.

SOUTHERN STATES.—As the Isthmian Canal comes nearer to commencement, attention is being attracted to the immense deposits of cement material in the Gulf States. At the request of Senator Morgan, a detailed survey of the cement resources of Alabama was undertaken in 1903 by the U. S. Geological Survey. The work was carried on by Dr. E. A. Smith and the writer, and the report was recently published as a Senate document. The material covers many square miles, is a soft chalky limestone, often nearly right in composition for use without admixture of clay, and is near to fuel and water transportation. The same rock also outcrops in Georgia, Florida and Mississippi, though in these states the fuel supply is less satisfactory. In case the Panama Canal is supplied with cement on its east side, the Gulf States cement deposits will have an immense advantage over those of any other locality.

CENTRAL AND WESTERN STATES.—In these states, from Ohio to California, and from South Dakota to Kansas, the cement industry has had a satisfactory year. This is particularly the case with the plants west of the Mississippi River. The materials used in the new plants are usually limestone and clay or shale, though at two plants a "cement rock," somewhat like that of the Lehigh district, is employed.